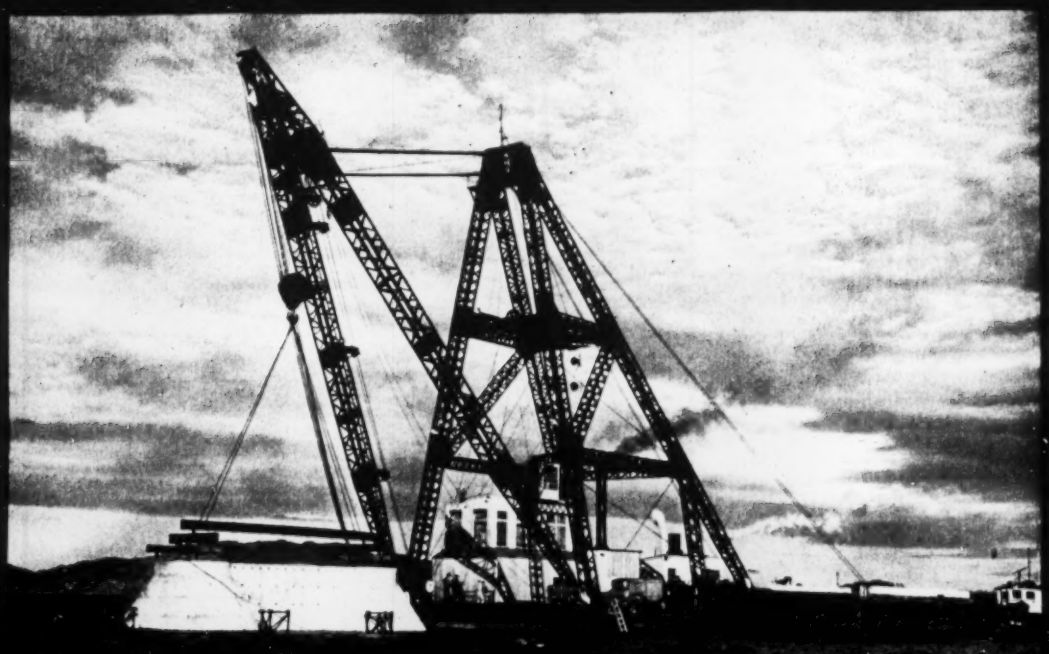
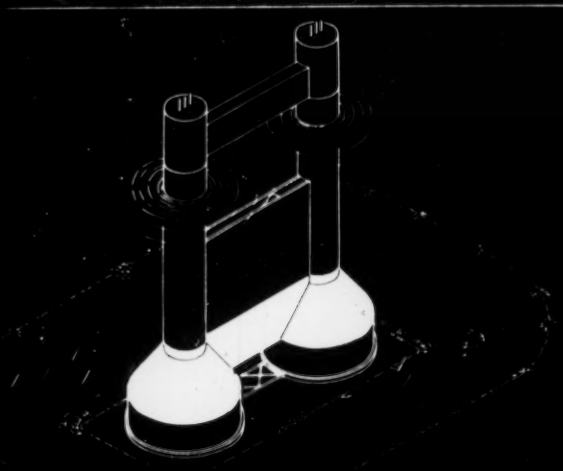
# CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION



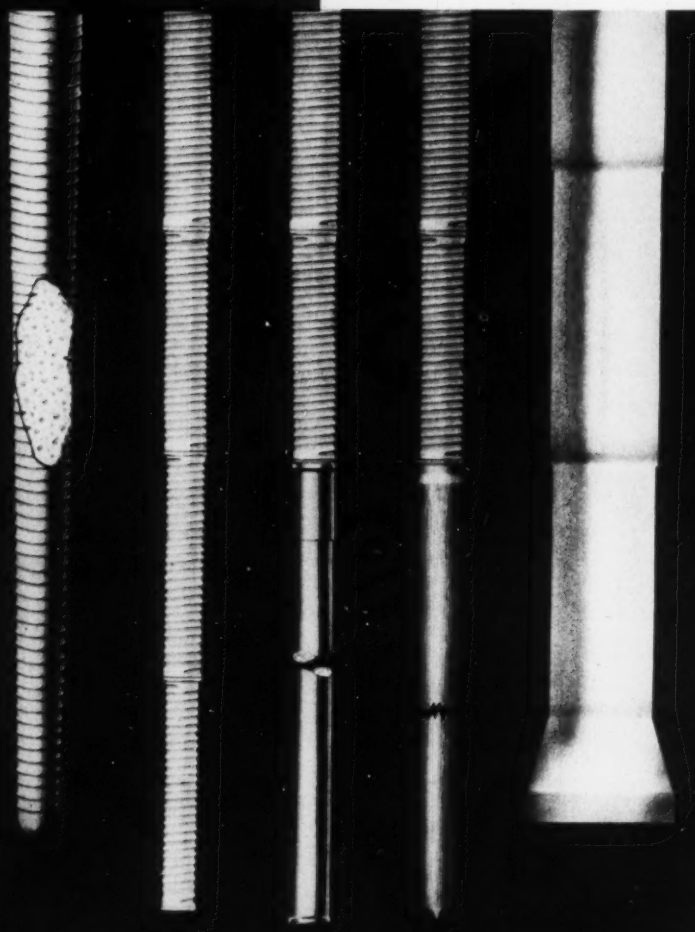


# engineered for the job!

* **ADVANTAGES OF RAYMOND CONCRETE PILES... Number four of a series**

**THE 5 TYPES OF RAYMOND PILES SHOWN... from left to right**

STANDARD • STEP-TAPER
PIPE STEP-TAPER
WOOD COMPOSITE • CAISSON



**REGARDLESS** of the subsoil conditions there's a Raymond Pile specifically designed to carry the required loads firmly and economically. Ideal as a friction pile is the Standard Pile with its heavy taper. Where hard ground must be reached at considerable depth below cutoff, the Step-Taper Pile is available. Where piles of very great length are required, the Pipe Step-Taper Pile is used. Wood Composite Piles combine the advantage of the permanence of concrete piles with the low cost of wood piles. Raymond Gow Caissons are efficient and economical for supporting heavy concentrated loads under certain soil conditions.

# RAYMOND

## CONCRETE PILE CO.

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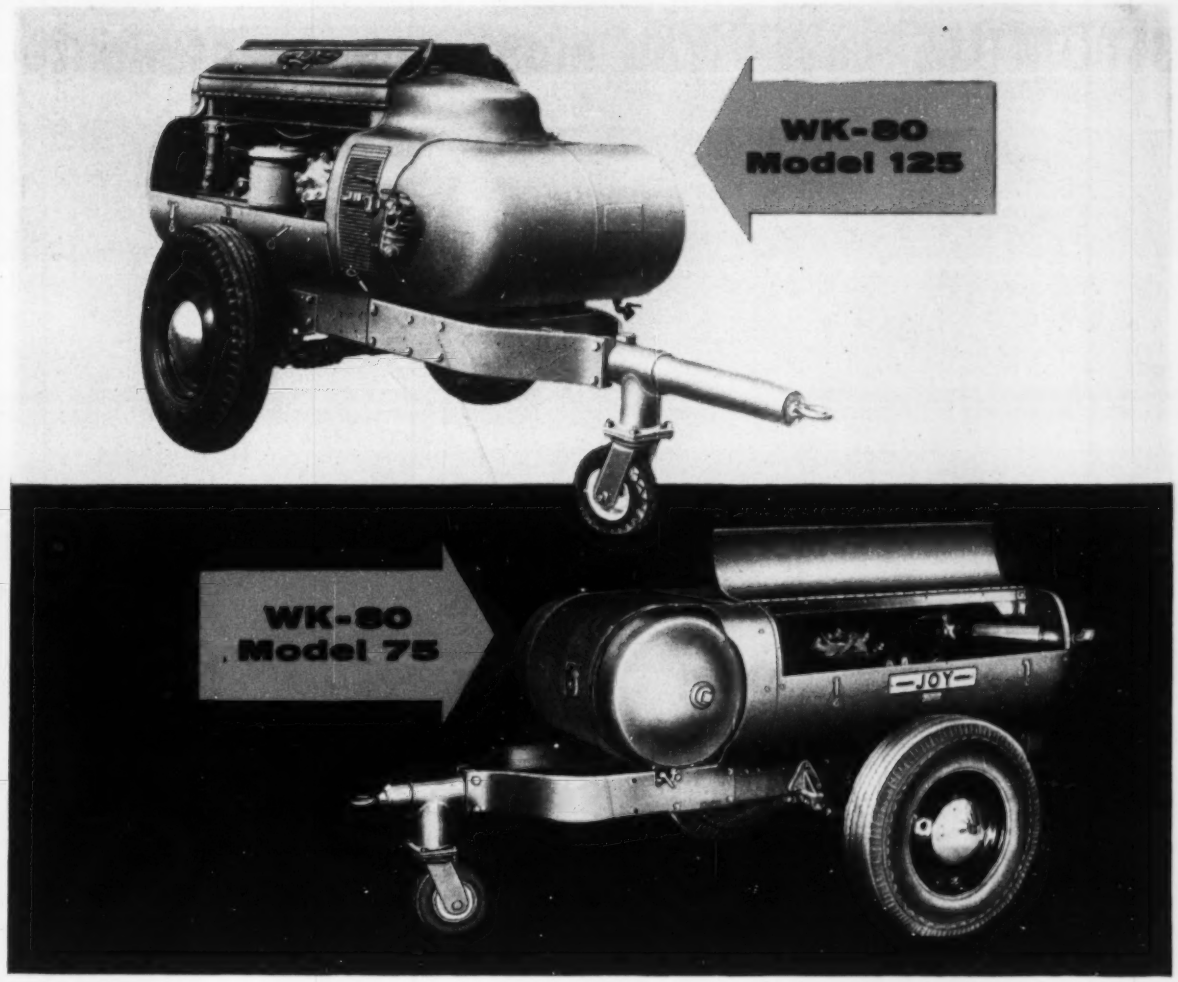
*Branch Offices in Principal Cities of the United States, Central and South America*

**RAYMOND'S DOMESTIC SERVICES**

Soil Investigations • Foundation Construction
Harbor and Waterfront Improvements
Prestressed Concrete Construction
Cement-mortar Lining of Water, Oil and Gas Pipelines, In Place

**RAYMOND'S SERVICES ABROAD**... In addition to the above, all types of General Construction.




# JOY announces 2 NEW LARGER SIZES OF PORTABLES

**. . . not "just speeded up", but built specifically to furnish today's higher air requirements while maintaining yesterday's slower speeds.**

These two new portables incorporate the outstanding features of the complete line of Joy Portables (now 75 to 630 CFM) . . . low piston speeds, direct-concentric valves, two stage compression, full force-feed lubrication, compact lightweight construction.

Write for complete details—ask for Bulletin A-55.

● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

*Consult a Joy Engineer*

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W&D C5070

**JOY**

**CONSTRUCTION EQUIPMENT MANUFACTURERS FOR OVER HALF A CENTURY**


CIVIL ENGINEERING, The Magazine of Engineered Construction, April, 1954. Vol. 24, No. 4. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

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# BITUMULS® saves you money on maintenance

BITUMULS IS ASPHALTIC BINDER IN EMULSION FORM. Applied cold, it bonds well with every type of clean surface; it thoroughly coats all types of aggregates, wet or dry. It can be used in damp weather and even at relatively low temperatures. For the deep penetration required on trench repair (above), Bitumuls has no equal.

These features add up to real savings on any maintenance program: you save the time and expense of heating: you eliminate the need of a special prime or tack coat: you work with local aggregate of all kinds, lowering the expense of importing material: you save time lost due to showers: and you can start work-season earlier, keep going later in the year.

Bitumuls is available in grades for all types of maintenance work. Fast Setting for Sealing, Surface Treatment and for Penetration work; Mixing Grades for fast, uniform coating of a wide range of aggregates, from sand to clay-gravel.

There are Bitumuls Engineers who work out of offices near you. Call on them whenever you feel that they can assist on maintenance problems.

Ask for our new booklet, "BITUMULS FOR MAINTENANCE." It gives full technical information, with methods of application.

**AMERICAN Bitumuls & Asphalt COMPANY**

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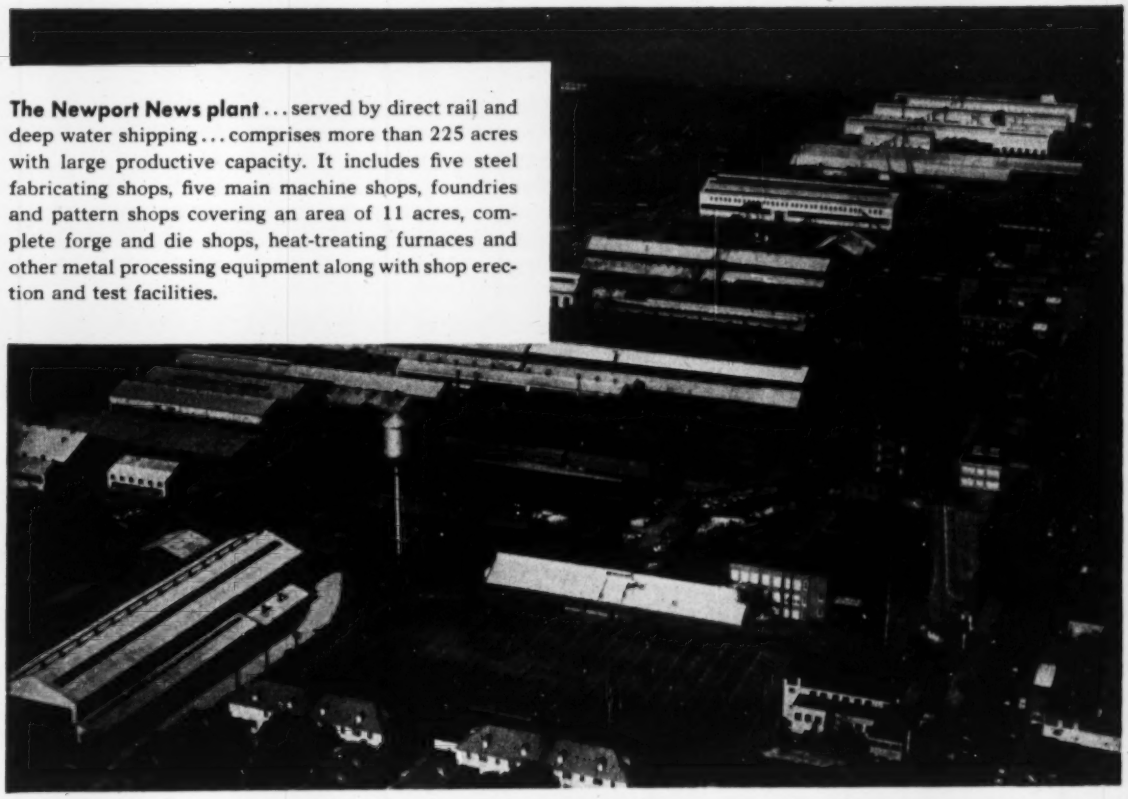
E. Providence 14, R. I. Perth Amboy, N. J. Baltimore 3, Md. Mobile, Ala.
Columbus 15, Ohio Tucson, Ariz. Seattle, Wash. Baton Rouge 2, La.
St. Louis 17, Mo. Inglewood, Calif. Oakland 1, Calif. Portland 7, Ore.
Washington 5, D. C. San Juan 23, P. R.

**The Newport News plant** ... served by direct rail and deep water shipping ... comprises more than 225 acres with large productive capacity. It includes five steel fabricating shops, five main machine shops, foundries and pattern shops covering an area of 11 acres, complete forge and die shops, heat-treating furnaces and other metal processing equipment along with shop erection and test facilities.



# Make Newport News your source for fabricated metal structures

Let Newport News fabricate your weldments or sub-assemblies. Call on us for plate fabrication...from vacuum tanks to bridge caissons ... for pumps, valves, pipe lines ... you'll find that Newport News fabricates parts to answer most demands.

In the vast plant, shown above, Newport News craftsmen complete your orders with specialized production techniques, and with sound experience acquired through construction of thousands of products ranging from small components on rayon spinning machines, to the giant 165,000 hp hydraulic turbines at Grand Coulee.

See for yourself what Newport News is doing, and how this company's high integration of skill and production facilities can help you. Get the facts, shown in *Facilities and Products*. A copy of this illustrated booklet is yours for the asking ... write for it now.

**Newport News**
**Shipbuilding and Dry Dock Company**
*Newport News, Virginia*

***They're here now!*** **28,000-lb. HD-15's with torque converter drive are already rolling off the assembly line.**

# Allis-Chalmers Powerful HD-15 adds to its big work advantages

**. . . now offers choice of two outstanding drives—**

**standard transmission with time-saving shift pattern,**

**or widely accepted hydraulic torque converter drive**

From its introduction, the Allis-Chalmers HD-15 has set new standards in performance and long-life service . . . in a new size class. It combines outstanding strength and balance with plenty of power, plus a simplified, time-saving transmission that gives big work output. In addition, the HD-15 offers remarkable service simplicity, with features like unit assembly and 1,000-hour lubrication intervals for truck wheels, idlers, and support rollers. It has proved itself the kind of tractor required on today's jobs.

*Now*, hydraulic torque converter drive is added as optional equipment — an additional working advantage for the powerful HD-15. This advanced design drive was introduced by Allis-Chalmers in the world's *first* torque converter tractor nine years ago. This modern drive gets more done because it automatically provides the right combination of speed and pull every working minute . . . and hydraulic cushioning assures longer life for both tractor and auxiliary equipment.

Now you can choose the HD-15 with standard transmission *or* hydraulic torque converter drive. Either way you'll be getting the most advanced tractor in the business. Let your Allis-Chalmers dealer give you *all* the reasons why.

**ALLIS-CHALMERS**
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

*Symbol of greater output, longer life.*

This modern structure—the Ottumwa Hospital—has frame and floors of reinforced concrete. According to the architect, Mr. Dane D. Morgan, reinforced concrete was selected because of its economy. He says, "We have used this type of hospital construction a number of times, and it has helped us produce low cost hospitals in the state."

Many architects and engineers are turning to reinforced concrete structures because reinforced concrete is less costly. Reinforced concrete goes up faster, is inherently firesafe, offers rugged strength, and permits great flexibility of design. Materials are readily available from local sources. On your next job . . . design for reinforced concrete.

# REINFORCED CONCRETE
## helped keep costs down!

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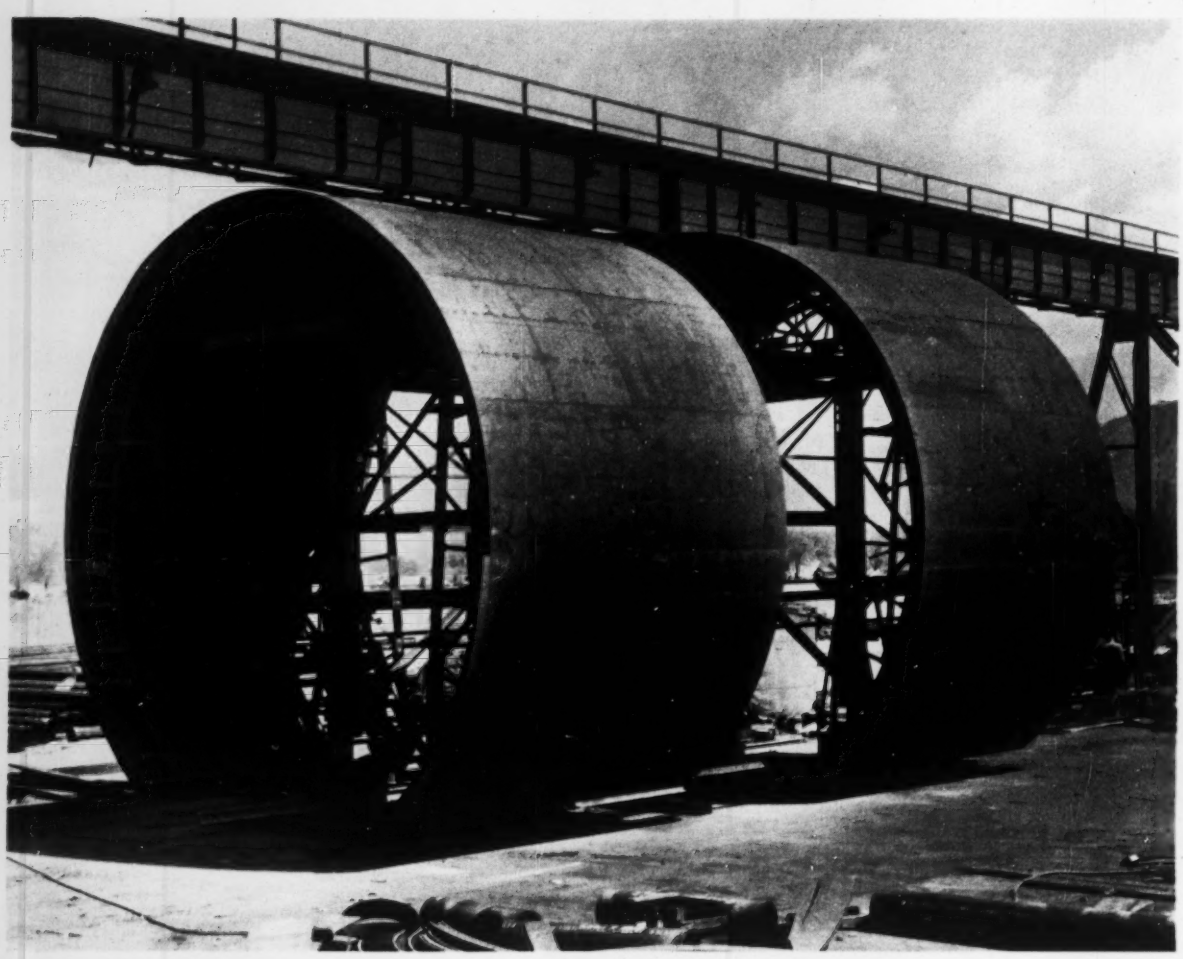
# Here's the answer to your **road building** problems!

● Add advantages of asphalt road construction or resurfacing . . . quick laying, easy upkeep, long service, low cost . . . to the availability of Standard Oil asphalt. That's the answer to your road building problems.

With five asphalt-producing refineries located throughout the Midwest, Standard offers you savings in shipping time and costs. Call your local Standard Oil office.

**STANDARD OIL COMPANY** STANDARD *(Indiana)*



# 26-Ft. Diam. Horton Steel Forms at Palisades Dam

Palisades Dam—located on the South Fork of the Snake River about 7 miles upstream from Irwin, Idaho, will be the largest earthfill dam ever built by the Bureau of Reclamation. When completed it will be 260 ft. in height above river bed, about 2,000 ft. long at the crest and contains nearly 14,000,000 cu. yds. of fill.

Two diversion tunnels for the Palisades Dam pierce Calamity Point, the left abutment, at about the level of the river channel. The tunnels are 1,210 ft. and 1,550 ft. long and will eventually serve as power and outlet tunnels. Two 26-ft. diam. by 20-ft. long Horton Steel Forms are being used to line the tunnels by J. A. Terteling and Sons, Inc., subcontractors on the completion of the tunnels from Palisades Contractors. Both forms were supplied with make up sections so that they can be converted in the field to make a 28-ft. diam. lining, and be used in other tunneling operations at the project.

Horton Steel Forms are engineered and built to fit the job on which they are used. Practical arrangement of hinges, ratchets, jacks and access doors allow the quick setting, accurate alignment and easy stripping that assure maximum speed. Sixty-five years of experience in steel plate construction enables Chicago Bridge & Iron to build forms for *you* that are practical and efficient . . . no matter what type of job!

When figuring on a job that will require steel forms, or any other type of welded steel plate structure, write our nearest office. Our engineers will be happy to supply any information, estimates or quotations that you may need.

*Chicago Bridge & Iron Company also builds jumbos, mixer carriages, screeds, batch boxes, gantrys and other appurtenances for use with steel forms.*

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***Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.***

# LOOK JOE! SAW CONCRETE & ASPHALT WITH A... Clipper CONSAW

## SAVES-

...UP TO 50% on REMOVAL TIME

...UP TO 50% on REPLACEMENT COSTS

The photos below illustrate typical concrete and asphalt removal practice now being employed by hundreds of Utilities, Municipalities, Contractors and Maintenance Crews in Streets, Floors and Sidewalks. The benefits include lower maintenance costs, lower installation, repair and replacement costs.

**CUT COSTS by Sawing Contraction Joints—Trench and Patch Openings in Concrete & Asphalt**

Save up to 50% in labor and material. Saw repair patches—water, gas, sewer and air line trenches in floors, streets, walks, highways. Save too, by sawing contraction joints in floors and highways...eliminate costly hand forming and spalling.

"4 OUT OF 5" BUY CLIPPER CONCRETE SAWS. Three-Point Suspension holds the blade straight and true in the cut—eliminates binding—twisting—drifting—sidewear and friction. The patented water application assures adequate coolant at all times—increased blade life and speed. Perfect balance and Dashboard Controls for operating ease and maneuverability.

**Experience Proves a Concrete Saw Must Have These Clipper Features for MAXIMUM ECONOMY**

3-POINT SUSPENSION | WATER SPRAY SYSTEM | INSTANTLY MANEUVERABLE

## FREE TRIAL ON YOUR JOB!

This unqualified Clipper guarantee of satisfaction is backed by Nearly 20 Years of world-wide experience, the ability to select the finest materials and the "know-how" to put them together. ORDER TODAY...on FREE TRIAL. Discover for yourself how Clipper will increase your profits!

***WORLD'S LARGEST MANUFACTURER OF MASONRY AND CONCRETE SAWS***

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...the First and Only saw in the world that will cut every masonry material regardless of size and hardness. Clipper outperforms them all for ONLY Clipper is "CONVERTIBLE" and has the Exclusive-Patented Features for **flexibility.** A Clipper model to fit any job—any budget. Sold on FREE TRIAL... Priced from $265.

**MODEL C-130—One of 5 Models—Gas or Electric Powered.**

***Quality is Consistent... Economy Certain with* CLIPPER SUPERIOR DIAMOND BLADES**

...guaranteed to..."Provide the fastest cut...at the lowest cost...with the greatest ease!" Clipper alone can supply every necessary metal bond... in over 36 specifications.

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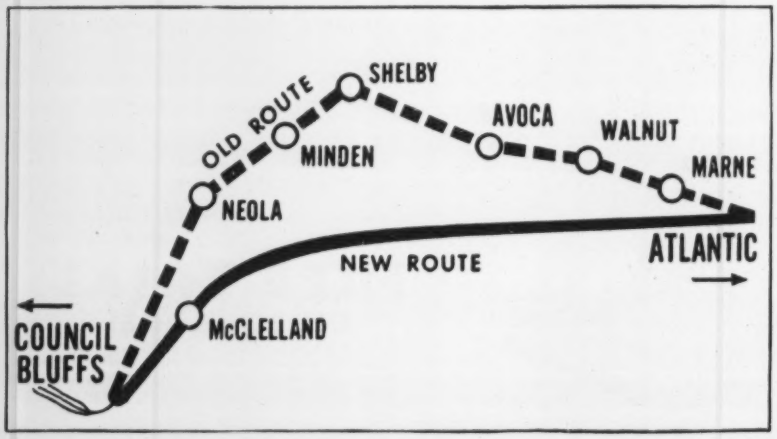
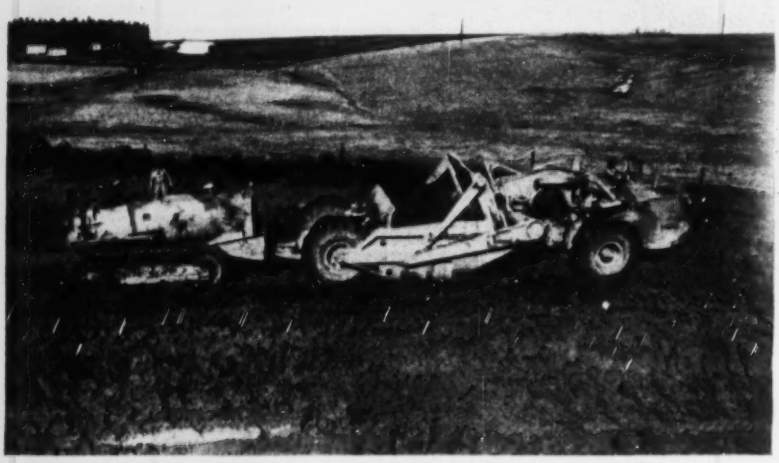
# 7,000,000 yards moved on Rock Island's Atlantic cut-off

## GENERAL DODGE'S ENGINEERING DREAM BECOMES REALITY AFTER 97 YEARS



Dead mud made much of the loading difficult. Here a Cat DW21 and Scraper are push-loaded by a D8. Often 3 pushers were required.

In September, 1953, the final spike was driven on the Atlantic-Council Bluffs cut-off of the Rock Island Lines. When the original main line to Denver was undertaken, back in 1857, General Granville M. Dodge recommended that it follow the new route. But picks and shovels and horse-drawn scrapers couldn't handle the immense cut-and-fill operation involved. The task had to wait for today's powerful earth moving machines.

The new line goes directly across the rough, hilly terrain of western Iowa, cutting the distance from 59.38 miles to 49.18, and reducing curves and grades. Cuts up to 70 feet were made through hills to fill the adjacent valleys.

The contract, completed by Orville Eblen Construction Co., of Atlantic, Iowa, called for the moving of 7,000,000 cubic yards of earth. Many of the hills that had to be cut through contained pockets of dead mud, between layers of impervious glacial clay. This made the going tough for normal scraper loading.

The bulk of the material was moved by 17 big-wheeled Caterpillar* units—twelve DW21s and five DW20s with Scrapers. The spread also included seventeen D8 Tractors, two D7s and six No. 12 Motor Graders.

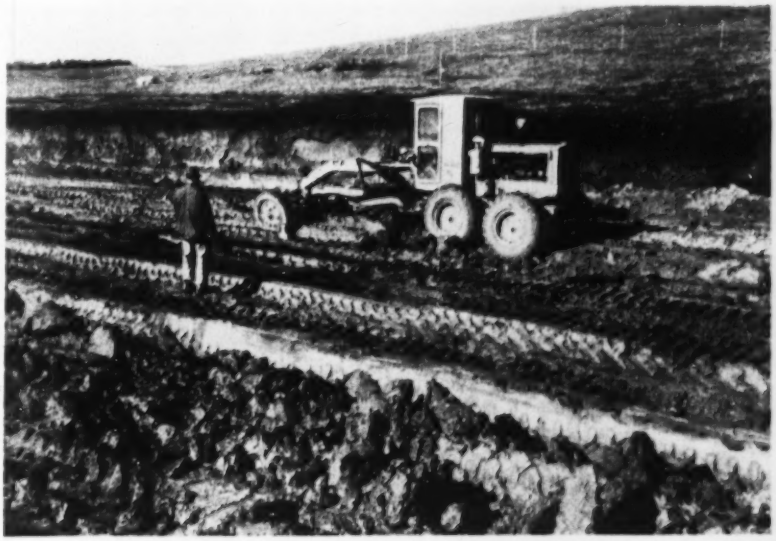
This is typical of the Iowa terrain traversed by the cut-off. Cuts up to 70 feet deep were common.

Mr. Eblen reports: "Both the DW21s and DW20s are well balanced, with adequate power, rugged transmissions, proper-sized rubber and strongly constructed scrapers. Yet at times it took the combined push of three D8s to overcome the tough mud conditions.

"In the face of these difficulties, our Cat* units have averaged over 300 hours of work per month on this job. I think no other machine built could have made such a record on this particular job."

The Atlantic cut-off has been an expensive undertaking, but it should well repay the Rock Island Lines. Faster schedules and lower hauling costs will be of direct benefit to the railroad, to shippers and to the traveling public.

*Both Cat and Caterpillar are registered trademarks—®



A Caterpillar No. 12 Motor Grader drives through the heavy going. 42 pieces of big yellow equipment were used on the job.

**CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U.S.A.**

# An important bridge needed a new pavement

*Washington Bridge at Providence, R. I., serves heavy traffic of US Route 1A, 6 and 44. Now paved with resilient Texaco Sheet Asphalt. Car track area was removed and repaved later.*

Washington Bridge at Providence, R.I., is a link in one of the main routes from New York City to Boston and Cape Cod. Traffic on the bridge runs as high as 41,000 vehicles a day, with trucks and buses representing about one-fifth of the total.

Last year, the State Department of Public Works decided to remove the old granite block pavement from the bridge, together with the car tracks. Now serving this heavy traffic is a resilient, heavy-duty Texaco Asphalt pavement, constructed in three courses, with a combined thickness of $4^1/_2$ inches.

The wearing surface of the new pavement is dense, durable, skid-resistant Sheet Asphalt. Scientifically graded sand and a 60–70 penetration Texaco asphalt were plant-mixed and laid to a thickness of $1^1/_2$ inches to provide this surface. Rhode Island is well acquainted with the ability of Texaco Sheet Asphalt to absorb punishing impact, as a result of the performance of this type of pavement under some of the State's heaviest traffic.

From Rhode Island to the Rockies, road builders have paved with Texaco asphalt products for over half-a-century. The first step toward insuring the uniformly high quality of these Asphalt Cements, Cutback Asphalts and Slow-Curing Asphaltic Oils is the scientific selection of the crudes from which they are refined. Throughout the refining process, these products are tested and retested to make certain they comply with the specifications in every respect.

***Write for two helpful booklets on Asphalt road types.***

## Rhode Island replaces old granite blocks with heavy-duty Asphalt pavement

***Removing old blocks and car tracks, preparatory to constructing three-course Texaco Asphalt pavement. Contractor: Narragansett Improvement Company, Providence.***

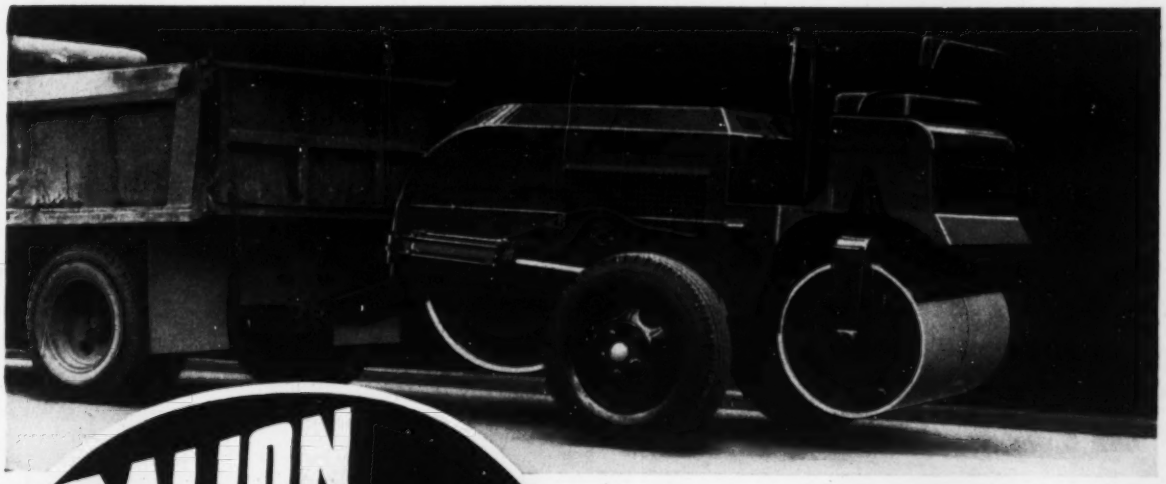
THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

Boston 16 • Chicago 4 • Denver 1 • Houston 1 • Jacksonville 2 • Minneapolis 3 • Philadelphia 2 • Richmond 19

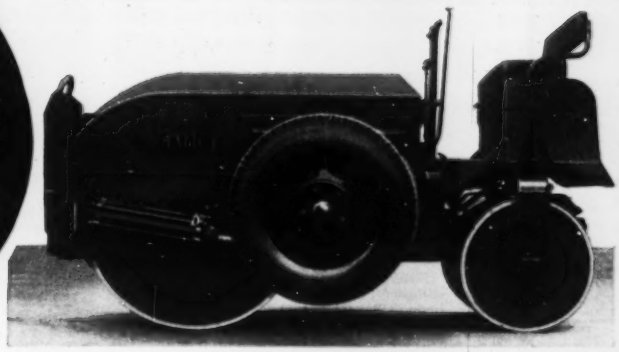
TEXACO

REG. T. M.

# TEXACO ASPHALT



# GALION 4 TO 6 TON PORTABLE TANDEM ROLLER *with retractable wheels*



## FEATURES

- Hydraulic jack (engine-operated) in towing hitch.
- Hydraulically-retractable, roller bearing, rubber-tire transport wheels.
- Hydraulic steering — easy to operate.
- Rugged spur gear drive.
- Constant mesh transmission.
- Variable weight — 144 lbs. up to 206 lbs. compaction pressure per inch of roll width.
- Large diameter compression roll for better compaction.
- Ample power — 25 h.p. air-cooled gasoline engine.

## HYDRAULIC OPERATION BY ENGINE-DRIVEN PUMP

Speedy and easy raising of the COMPLETE roller unit off the ground is accomplished by simple finger-tip hydraulic control. Built-in hydraulic jack in truck hitch raises compression roll, and retractable transport wheels raise the steering roll.
Saves valuable working hours to and from the smaller compaction jobs.
Write for complete information.

OTHER GALION PRODUCTS
Motor Graders • Three-Wheel Rollers • Tandem Rollers • Portable Rollers • Trench Rollers

ESTABLISHED GALION 1907

MOTOR GRADERS • ROLLERS

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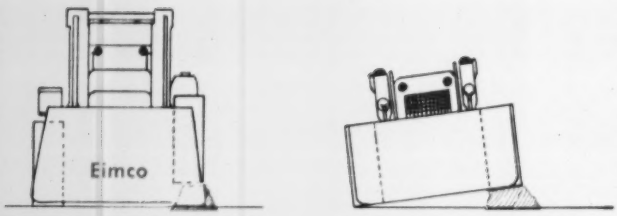
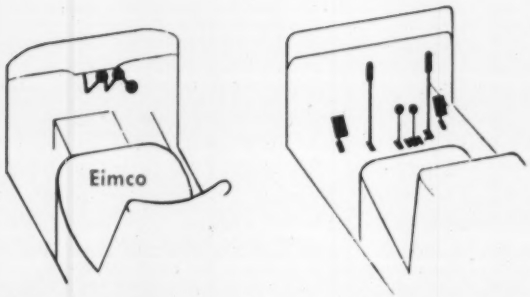
Cable address: GALIONIRON, Galion, Ohio

# EIMCO

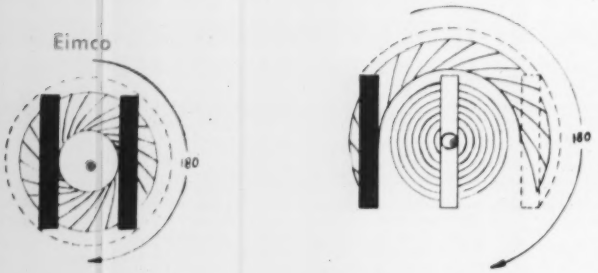
## WORLD'S FINEST TRACTOR EXCAVATOR



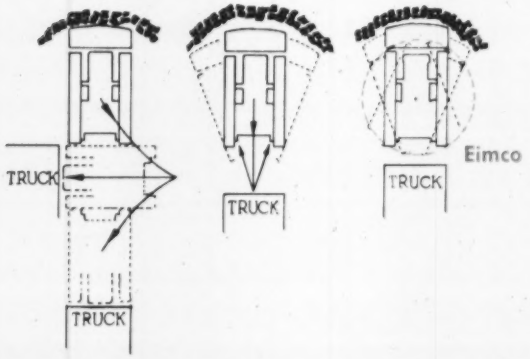

**OSCILLATION** — with loader attachment — exclusive on Eimco 105, this feature permits better loading on uneven floors in pits or stripping operations.



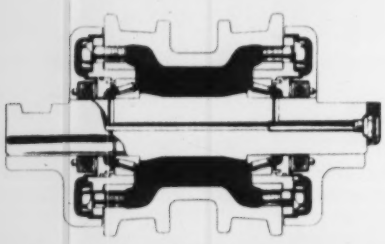

**EASY SIMPLE CONTROLS** — Eimco's easy finger tip controls give better maneuverability with less effort. Change speeds without stopping — instant reverse.




**INDEPENDENT TRACK OPERATION** — In a turn one track runs forward, the other reverse, cutting turning radius to a minimum. Eliminates excessive wear on track, rollers, idlers and track frame. On most machines one side is locked and skidded for a sharp turn.




**MANEUVERABILITY** — Faster loading into haulage units because of Eimco's overhead loading action and independently controlled tracks. Note trucks can be kept closer, cutting haulage time.



**THE EIMCO 105 TRACK ROLLER** — A one piece cast alloy steel roller with bearing cages and husky shaft on Timken roller bearings completely sealed against dirt and moisture. Careful heat treatment prolongs life and maximum grease capacity assures lubrication.

**BETTER VISIBILITY** — The operator sits up front where he can see. Loading, bulldozing or pushing are more efficient, eliminate guesswork.

Every feature of the Eimco 105 is designed for maximum customer service with minimum maintenance. One of these features is the full oscillating track **EVEN WITH THE LOADER ATTACHMENT.** This is an exclusive feature on the Eimco 105 since standard practice in the construction field is to tie the tracks rigidly when a loader is mounted on any tractor unit.

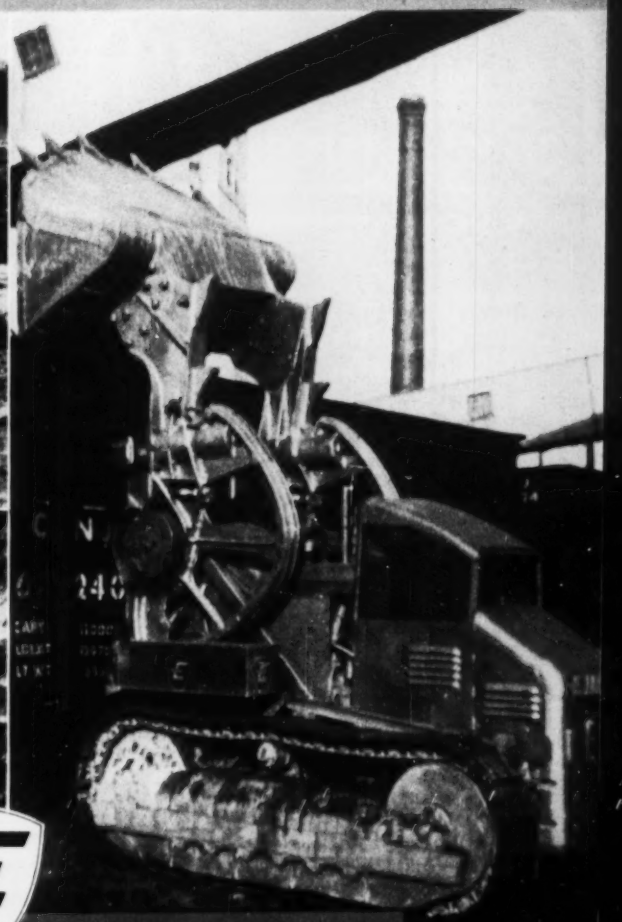
The full oscillating feature prevents excessive frame twist, wear on tracks, rollers, and idlers. Traveling on uneven ground the heavy equalizer bar supports the front end of the tractor and rides freely in its universal type socket in each track roller frame so that either track is free to move up or down without tilting the engine or frame.

This feature provides maximum ground contact under all conditions and maximum drive which is essential in good digging and loading.

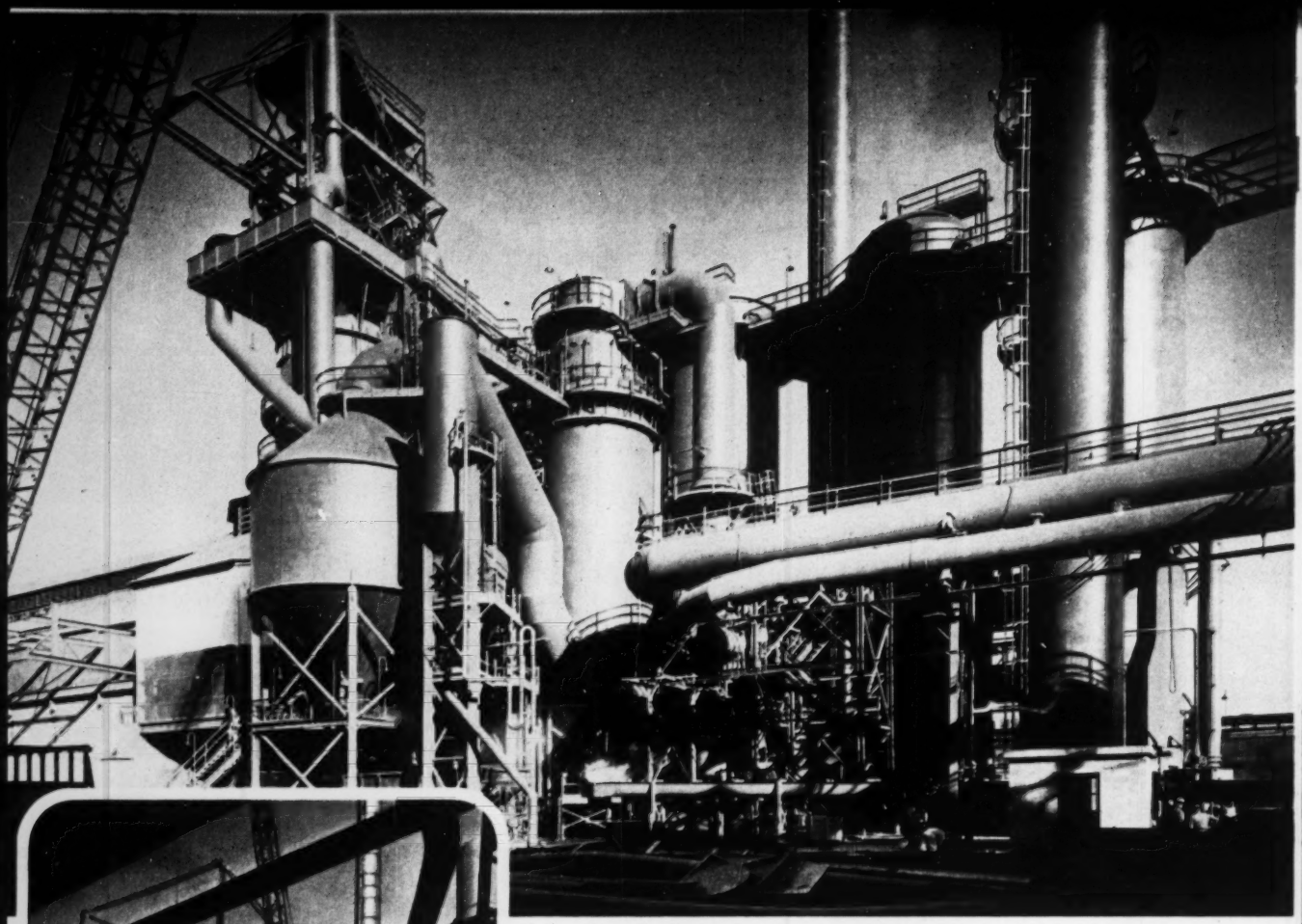
Write for information to The Eimco Corporation, P. O. Box 300, Salt Lake City, Utah.

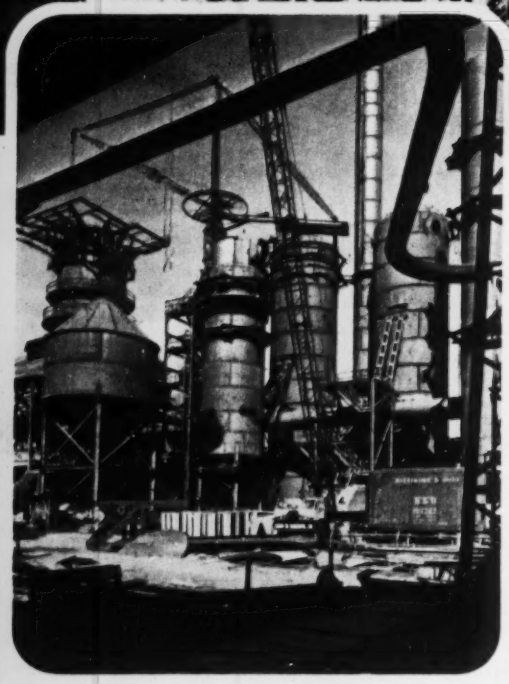
WITH COST SAVING ADVANTAGES

**Above left: Eimco 105 digs in stock pile of chunky limestone. Above right: Two speed bucket mechanism loads light trucks easily and fills big trucks full. Below left: Loading rock from pit. Bottom: Clearing slide area after heavy rain. Below right: High discharge loads into high railroad cars.**



THE EIMCO CORPORATION





Completed project (top) and construction view of blast furnace shell, hot blast stoves, stack, dust catcher, and inter-connecting ducting and walkways. Built for Pittsburgh Coke and Chemical Company, Neville Island, Pittsburgh, Pa.

*for every type of*

# STEEL PLATE CONSTRUCTION

—broad resources
—undivided responsibility
—guaranteed satisfaction

# PITTSBURGH •DES MOINES

Let us quote on your current steel plate construction requirements—whether for a blast furnace with its accessories; large hydro-electric power penstocks; or the simplest, smallest project where fine craftsmanship and experience are desired. *Write, phone or wire.*

## PITTSBURGH•DES MOINES STEEL CO.

**Plants at PITTSBURGH, DES MOINES and SANTA CLARA**

***Sales Offices at:***

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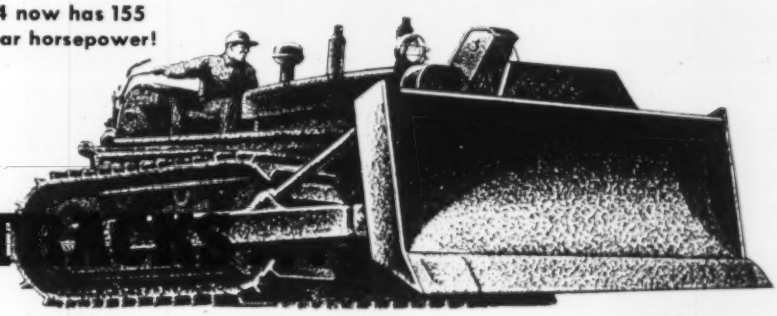
**CHICAGO (3), 1274 First National Bank Bldg.**
**LOS ANGELES (48), . . . . 6399 Wilshire Blvd.**
**DES MOINES (8), 971 Tuttle Street**
**DALLAS (1), 1275 Praetorian Bldg.**
**SEATTLE . . . . . 578 Lane Street**
**SANTA CLARA, CAL., 677 Alviso Road**

STILL THE CHAMP!

TD-24 now has 155 drawbar horsepower!



ON T[illegible]

2T-75 rubber-tired tractor with scraper

ON RUBBER

See it now at your INTERNATIONAL Industrial Distributors—a complete line of modern earthmoving equipment, led by the INTERNATIONAL TD-24, "The Champ" of crawler power and by the INTERNATIONAL two-wheel, rubber-tired tractors with scrapers.

Then see it in action on your own job—in a demonstration of INTERNATIONAL "power that pays."

"JOB-PHASED" EQUIPMENT
FOR EVERY MOVE IN EARTHMOVING

INTERNATIONAL HARVESTER

INTERNATIONAL

2T-75 rubber-tired tractor with scraper

# IH – For Every

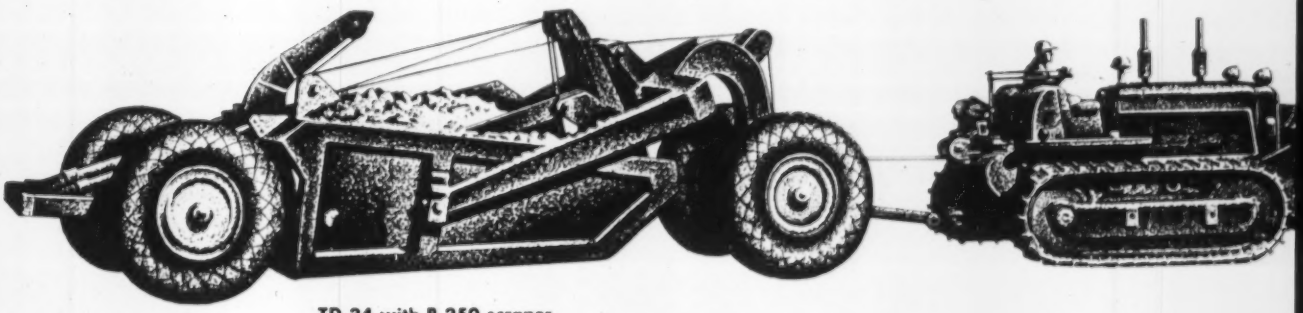
# INTERNATIONAL presents a complete line of "Job-Phased" equipment—on tracks and on rubber for every earthmoving job.

- Seven rugged crawlers, led by the INTERNATIONAL TD-24.
- Twenty-two matching hydraulic and cable-controlled bulldozers and bullgraders.
- Four 4-wheeled scrapers.
- Two high-speed, two-wheel, rubber-tired tractors with scrapers (13 and 18-yard heaped capacity).
- A high-speed two-wheel, rubber-tired tractor with bottom dump wagon (20-yard heaped capacity).
- Four front-end loaders, for the TD-6 through the TD-18A—tops for excavating, materials handling and general utility work.

All under the INTERNATIONAL banner. All proved on-the-job for dependability and economy. All sold and serviced by men who know construction equipment and construction problems—the finest distributor organizations in the industry.

For full details on the *complete* line of INTERNATIONAL earthmoving equipment, check with your INTERNATIONAL Industrial Distributor today.

**PAYLOAD EXPRESS.** INTERNATIONAL 2T-75 rubber-tired tractor with heap-loaded scraper comes roaring around a tight curve in the cut.



TD-24 with B-250 scraper

**HOW TO BUILD A DAM FAST.** INTERNATIONAL TD-24 crawler dozes and tamps with 4 massive sheepsfoot rollers in a single operation.

INTERNATIONAL HARVESTER

INTERNATIONAL

# Move in Earthmoving

# Now All in One Family

## *the hardest-working work teams in the world!*

The new INTERNATIONAL team stars not only a full line of rugged red INTERNATIONAL crawlers, complete with INTERNATIONAL scrapers and bulldozers, but also high-speed INTERNATIONAL two-wheel, rubber-tired tractors with scrapers.

This means that now, more than ever, your INTERNATIONAL Industrial Distributor is "Earthmoving Headquarters" for your area. He offers you IH equipment to tackle any job, backed up by unsurpassed service facilities and parts supplies.

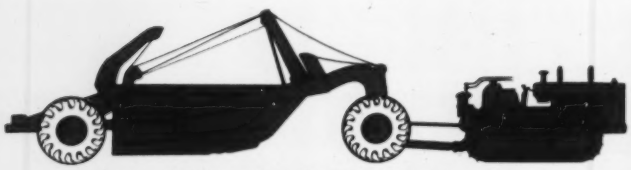
He's at your call, always, to help keep your equipment rolling . . . to cut down your down-time and pile up your profit-time . . . to serve you with INTERNATIONAL "Power that Pays!"

**INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS**

INTERNATIONAL HARVESTER

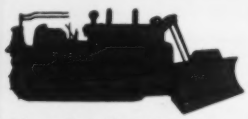
**INTERNATIONAL**

**FOR EVERY MOVE IN EARTHMOVING**

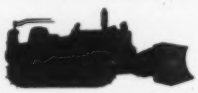


TD-24 crawler with matched scrapers

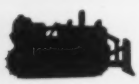
TD-18A crawler with matched scrapers



TD-24 crawler with bullgrader



TD-14A crawler with cable bullgrader



TD-9 crawler with hydraulic bulldozer

TD-9 tractor with front-end loader

TD-6 crawler with hydraulic bulldozer

TD-18A crawler with sideboom

Model 2T-75 two-wheel, rubber-tired tractor with 18 heaped-yard capacity scraper

Model 2T-75 two-wheel, rubber-tired tractor with 20 heaped-yard capacity bottom dump wagon

Model 2T-55 two-wheel, rubber-tired tractor with 13 heaped-yard capacity scraper

# If FASTER COMPLETION cuts costs...

*For huge industrial projects like this, or for the smallest of jobs, Monotube piles meet every engineering requirement while saving time and dollars.*

*Monotube Foundation Piles*

## look how MONOTUBE PILES can help!

**1. LIGHT WEIGHT.** Much faster driving due to reduced inertia. No need for a core or mandrel. More piles driven per rig per shift!

**2. SIMPLIFIED PROCEDURE.** Light standard cranes suffice. They move in quickly. Setup and moving time is cut. Over-all time and costs are reduced.

**3. EXTENDIBILITY.** Quickly, easily weld-spliced to *any* length, on the spot, using standard extensions or cutoffs. Because of light weight, high strength and easy handling, field welding goes *fast.* No difficult welding operations.

Here are just a few of the cost-important reasons why more and more jobs are getting off to a good start with Monotube piles. Get *all* the facts. Write to The Union Metal Manufacturing Co., Canton 5, Ohio, for Catalog No. 81.

**UNION METAL**

# PREPAKT ANNOUNCES NEW *Mixed-in-Place* GROUTING TECHNIQUE FOR FOUNDATION STABILIZATION...

Here's a remarkable new construction technique!

Now, soils can be stabilized in place . . . load-bearing piles placed without objectionable pile-driving vibration . . . cut-off walls constructed without excavating, shoring or backfilling . . . cofferdams installed (to replace sheet piling) which reduce excavation, eliminate backfill and later serve as outside forms.

All this and much more can be done with Prepakt's revolutionary development—*Mixed-in-Place Intrusion Grouting*.

Economical and easy-to-use, the procedure consists of injecting Intrusion grout through a hollow shaft to a rotating drill head which mixes it with the soil in place. The soil is not withdrawn—but is used as the aggregate. The result: a pile-like column of considerable load-bearing capacity useful for both bearing piles and cut-off walls.

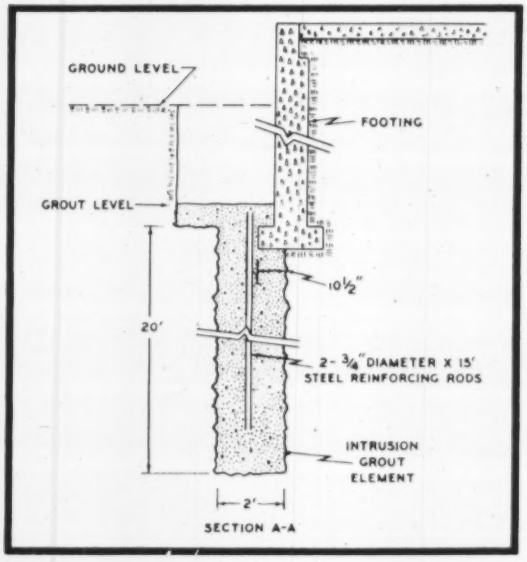
The mixed-in-place grout piles, which may be up to 24 inches in diameter, can be made in most any soil including clay, silt, sand and gravel. Pile strength varies with the type of soil and is as great as concrete in sand or gravel.

All necessary equipment is truck-mounted on a single, highly mobile rig which can operate in locations normally inaccessible to pile-driving units. Other advantages over driven piles include (1) no damaging vibration or ground heaving and (2) higher skin friction between elements and soil.

Prepakt's *Mixed-in-Place Intrusion Grouting* gives the construction industry a new "tool" for solving difficult foundation problems.

For further information on Prepakt's new *Mixed-in-Place Intrusion Grouting* technique, contact the Main Office, Room 779-L, Union Commerce Bldg., Cleveland.

BUILDING SETTLEMENT HALTED—Some 60 Mixed-in-Place Intrusion Grout piles were used for underpinning an Omaha warehouse being damaged by continued settlement. Photo (above) shows truck-mounted rig in action close to building. Use of 24" bit allowed 10½" of blade to work under spread footing for better support. Diagram (below) indicates that Prepakt method minimized excavation and eliminated casting of pile cap.




CONTRACTORS PREPAKT ENGINEERS

**INTRUSION-PREPAKT, INC.**
**THE PREPAKT CONCRETE CO.**

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**PEDESTRIAN BRIDGE** for Mt. Carmel High School, Lawson, Kentucky. This is one of the smallest suspension bridges designed and fabricated by American Bridge in many years. Structure was erected by the faculty and students of the school.

# Study in Extremes
by
# AMERICAN BRIDGE

**SAN FRANCISCO-OAKLAND BAY BRIDGE** fabricated and erected by American Bridge is the world's greatest. It is 8½ miles between terminals of which 4½ miles is steel superstructure over San Francisco Bay.

MOST people associate American Bridge with *big* bridges. And that's understandable, for they're the ones that make the headlines.

But, American Bridge also builds small bridges. In fact, we have recently designed and fabricated a part of an exceptionally small suspension bridge. We show it here. And to give you a better idea of the wide variety of our work, we also show a picture of the famous San Francisco-Oakland Bay bridge, the world's greatest bridge.

What a study in extremes! The little pedestrian bridge is only 402′ 7½″ long and 6′ wide, while the main structure for the tremendous San Francisco-Oakland Bay bridge is 22,720′ long. It has two main suspension spans, each 2,310′ long. The main span of the tiny foot bridge measures but 244′ 7½″! The total weight of the smaller structure is approximately 25 tons; steel for the larger job weighs 201,000 tons!

Contrasting these two bridges is just another way of saying that no bridge is too large or too small for American Bridge. We have the fabricating facilities, erecting equipment and technically trained personnel to handle any type of steel construction with exacting precision, thoroughness and speed . . . any time, anywhere. For detailed information regarding your requirements, call our nearest office.

### Interesting Movie Now Available for FREE Showing

The new sound and color motion picture—*Building for the Nations*—a candid, factual photographic record of the highlights of the fabrication and erection of the United Nations Secretariat Building in New York is now available for free showing in churches, schools, clubs and industries. For bookings, write Pittsburgh office.

**AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION • GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.**

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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

# AMERICAN BRIDGE

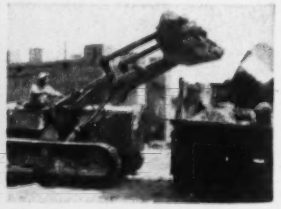
USS

UNITED STATES STEEL

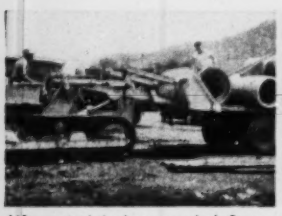
Stockpiles coal, sand, aggregate. Has traction and flotation to work right up on the pile.

Excavates, fills, levels. Compact — for work in limited areas.

Backfills ditches, packs and levels ground with 16,200 lb. weight.

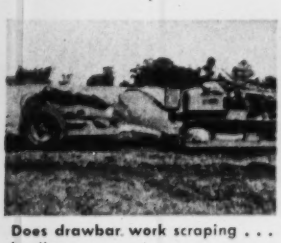


Cleans up rubble with one-cu. yd. tractor-width bucket.



Lifts material where needed. Saves manpower and need for other equipment.

Does sanitary fill work — digs, fills, covers, levels.



Does drawbar work scraping . . . hauling.

Landscapes, grades or slopes lawn areas around building projects.

**ALLIS-CHALMERS HD-5G**

# Always Busy...

## because it does so many jobs so well!

Busy equipment is profitable equipment. And thousands of owners are learning every day the year around that there's no more profitable machine on their jobs than the one-yard Allis-Chalmers HD-5G Tractor Shovel.

Loads sand, dirt, snow — any material to dumping height of 9 ft., ¼ in.

### TEN QUICK-CHANGE ATTACHMENTS ADD TO HD-5G VERSATILITY

| | |
|---|---|
| Bulldozer | Trench Hoe |
| Narrow Bucket | Lift Fork |
| Rock Bucket | Tine Fork |
| Crane Hook | Rock Fork |
| Light Material Bucket | Ripper |

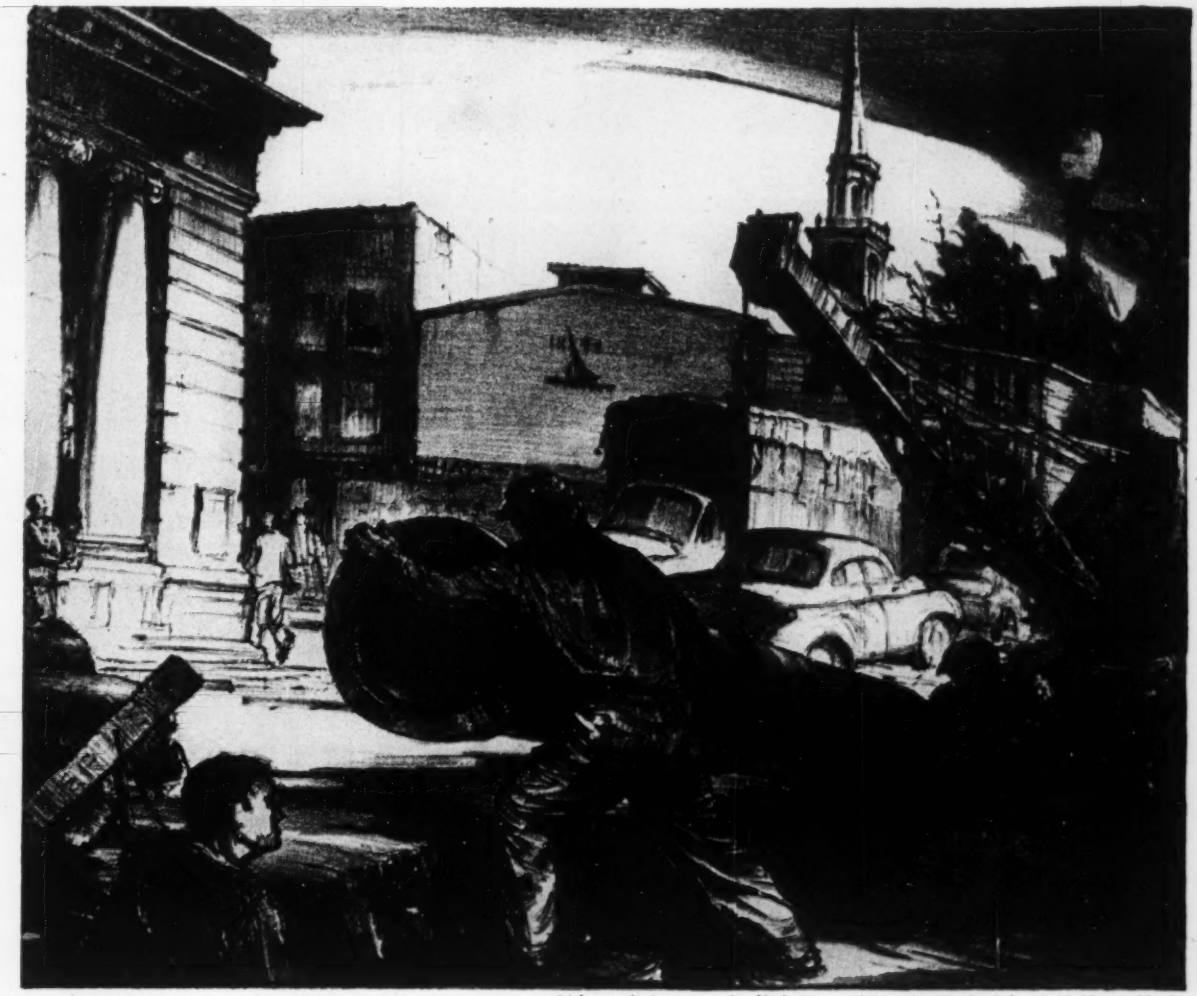
Larger size Allis-Chalmers tractors with shovels and other quick-change attachments offer the same wide utility, the same outstanding performing ability as the popular HD-5G. Choose the one that fits your needs.

| 1-YD. HD-5G | 2-YD. HD-9G | 3-YD. HD-15G | 4-YD. HD-20G |
|---|---|---|---|
| 40.26 drawbar hp. | 72 drawbar hp. | 109 drawbar hp. | 175 net engine hp. |
| Dumping height* | Dumping height* | Dumping height* | Torque Converter Drive |
| 9 ft., ¼ in. | 11 ft., 4 in. | 12 ft., 8 in. | Dumping height* |
| | | | 13 ft., 5 in. |

*Height of bucket hinge

# ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.



*Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.*

**THIS ILLUSTRATION** shows the laying of cast iron pipe in the business section of a small town, which could be for water, gas or sewerage service. Such a situation calls for a pipe with proved long life to be placed beneath the costly permanent pavement. Whether in the business district, residential area or the country, cast iron pipe has established an enviable record of low cost per service year.

We are in an excellent position to furnish your requirements for cast iron pipe, either centrifugally cast in sizes 2- to 24-inch or pit cast for larger sizes—all of which are produced under rigid quality controls and in accordance with standard specifications.

**U.S. CAST IRON PIPE**

**United States Pipe and Foundry Co.,**
**General Office, 3300 First Ave., N. • Birmingham 2, Ala.**
**Plants and Sales Offices Throughout the U. S. A.**

Though 50% of this block was destroyed, the Roosevelt Hotel (background) with reinforced concrete frame and floors came through undamaged structurally.

# Reinforced Concrete Construction Withstands Destructive Waco, Texas Tornado

Above: Two-story building at right with reinforced concrete floors, walls and roof came through the tornado without structural damage but the adjacent structure suffered extensively. Below: This one-story warehouse was built in two sections. The section with reinforced concrete frame, floors and roof was undamaged; the other part was demolished.

The tornado that struck Waco, Tex. on May 11, 1953 killed 115 persons and wrecked property worth millions of dollars. It ripped a path of destruction one mile wide and four miles long.

Nevertheless some buildings within this area of devastation withstood the full fury of the tornado. An engineering report made following a thorough examination of the damage said, "Without exception structures with reinforced concrete frames suffered little damage."

This is graphic evidence that reinforced concrete construction can "take it." Schools, hospitals, factories, office buildings, apartments —any structure—can be designed in concrete to resist the violent lateral forces and bursting pressures of tornadoes, hurricanes and atomic blast.

In addition reinforced concrete construction offers the durability, strength, firesafety, attractive appearance and ***low annual cost*** that are desirable in any structure. For more information write for a copy of free, illustrated literature, distributed only in the United States and Canada.

**PORTLAND CEMENT ASSOCIATION**

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

**Dept. 4-13, 33 West Grand Avenue, Chicago 10, Illinois**

**OPERATION: GOLDFISH BOWL**

● *The Manufacturers Trust Company building at Fifth Avenue and Forty-Third Street in New York is a fine example of modern design. Architects: Skidmore, Owings & Merrill. General Contractors: George A. Fuller Company. Structural Engineers: Weiskopf & Pickworth.*

## FABRICATING STEEL IS OUR BUSINESS

Ingalls, the nation's leading independent steel fabricator, supplied the steel for the handsome, modern Manufacturers Trust Company building in the heart of America's largest city.

Thousands of commercial and industrial buildings, constructed during the past 44 years and located here and there about the country, are proof that Ingalls can meet any fabricated steel requirement, regardless of size or location. Plants in Pittsburgh, Birmingham, Pascagoula, Mississippi, and Decatur, Alabama, assure *you* of a service that's prompt, efficient and economical.

**FABRICATED STEEL FOR**

Power Plants ● Hangars ● Stadia
Bridges ● Stores ● Office Buildings
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Pressure Vessels ● Stacks

*For complete information, write:* **THE INGALLS IRON WORKS COMPANY**

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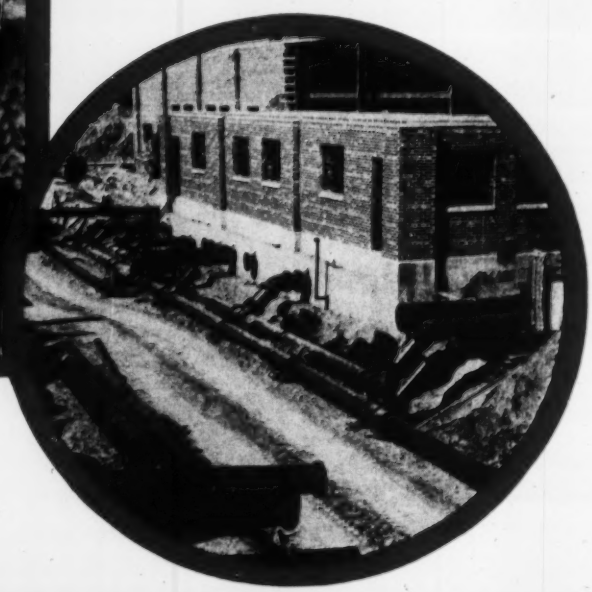
***Sales Offices:*** *New York, Chicago, Pittsburgh, Houston.*

***Plants:*** *Birmingham, Ala., Verona, Pa., North Birmingham, Ala., Pascagoula, Miss., Decatur, Ala.*

# For TOUGH assignments

When pipe is to be installed under conditions which make repairs difficult at best, the engineering profession relies on cast iron pipe. Such installations, for example, as outfall sewers, river crossings, and sealed piping in sewage treatment and water filtration plants. *Any* installation, where repairs should be a remote possibility, calls for rugged cast iron pipe. Its great beam-strength, compressive-strength and shock-strength—plus its effective resistance to corrosion—result in long life with negligible repairs and maintenance cost. For information write: Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

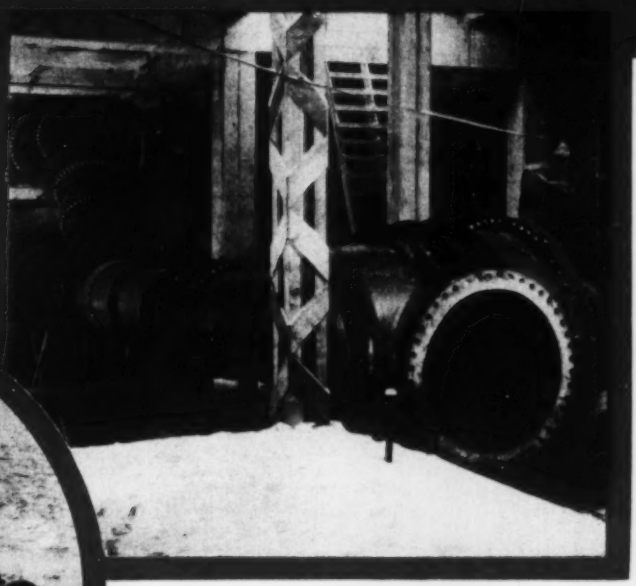


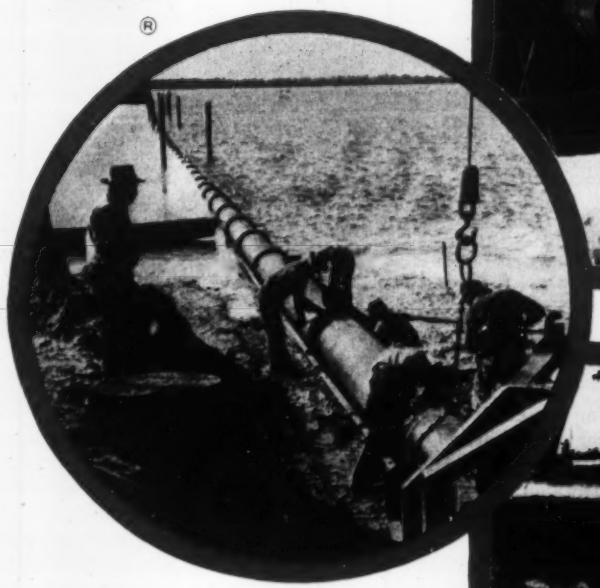
(above)
Installing cast iron belt feeder main for water supply system in Casper, Wyoming.

(right)
Cast iron pipe for discharge lines from water circulating pump house in a midwest oil refinery.

# CAST IRON PIPE

# use this RUGGED pipe



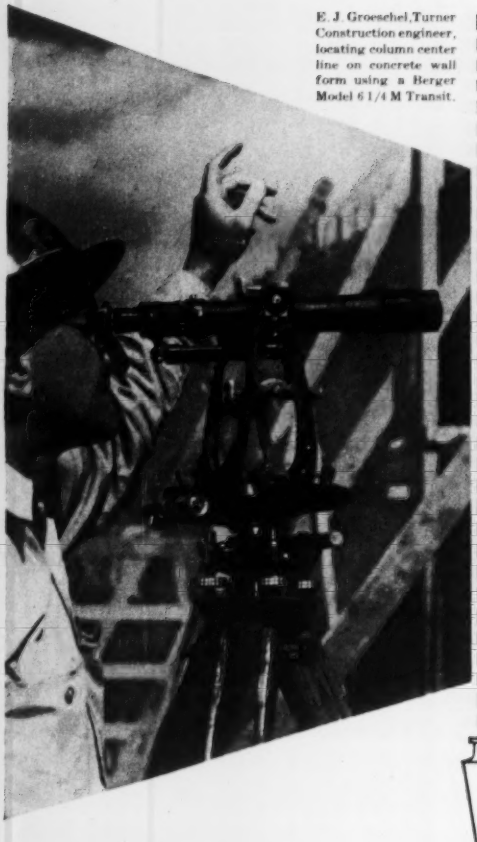


(above)
Cast iron pipe for outfall into St. Joseph Sound from sewage disposal plant at Dunedin, Fla.

(top right)
Cast iron pipe and fittings installed in world's largest water filtration plant in Chicago, Ill.

(at right)
Installing 30" cast iron pipe for sewage treatment plant at Panama City, Fla.

SERVES FOR CENTURIES



E. J. Groeschel, Turner Construction engineer, locating column center line on concrete wall form using a Berger Model 6 1/4 M Transit.

# sighting on new lines of sound with BERGER TRANSITS

The building "specs" laid down for the new White Plains, N. Y. long distance dial switching center of the American Telephone and Telegraph Company's Long Lines Department left no room for compromise with accuracy. To house the delicate telephone line equipment and mammoth machinery—

**Foundations for diesel generators and other heavy mechanical equipment must be "dead level"...**

**Surfaces of finished floors must be free of depressions and high spots and not vary by more than 1/8" when tested with a 10-ft. straight-edge—maximum allowance over an entire area limited to 3/16"...**

**Forms placed in successive units for a continuous surface must be so accurately aligned that completed surface would be smooth and free from irregularities...**

**Column center lines and wall lines for the reinforced concrete exterior walls and interior concrete partitions must hold extremely close tolerances—as do all footings, foundation walls, lines and grades.**

Turner Construction Company, nationally known builders, were selected to erect this unusual building—and Berger Transits were on the job, as they are on so many other Turner projects. For when the "specs" call for really close-tolerance surveying, leading engineers and construction men buy Berger. Take one into the field and see why.

**Write for a copy of "ACCURACY IN ACTION"**

C. L. Berger & Sons, Inc., 37 Williams St., Boston 19, Mass.
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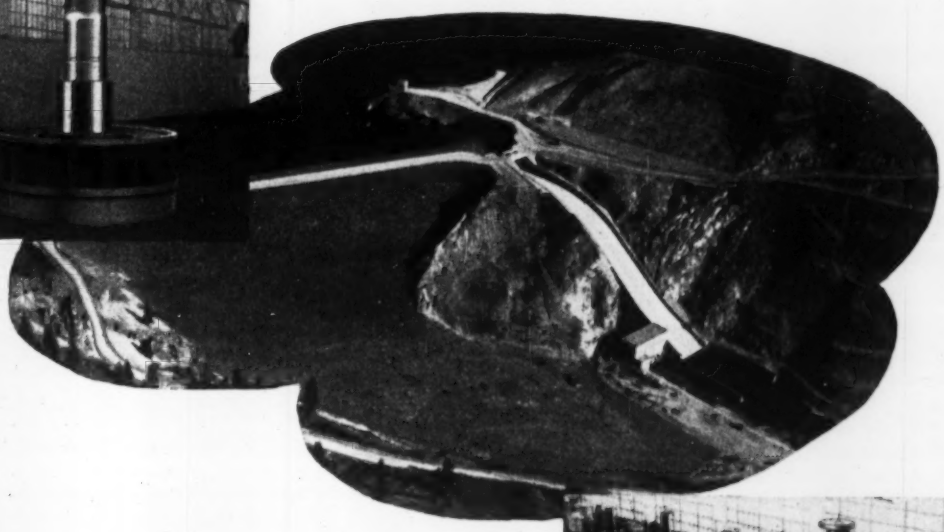
**THE BEST IN SIGHT IS BERGER**

**ENGINEERING AND SURVEYING INSTRUMENTS ... SINCE 1871**

# The *"Anderson Ranch"* POWER PROJECT
## United States Bureau of Reclamation



## hydraulic turbines by **LEFFEL**

Anderson Ranch Dam, located on the Boise River in Idaho, U. S. A., is the highest earth-fill dam in the world. Two Leffel turbines are installed in the Anderson Power Plant which provides power for the surrounding area. The turbines are of the cast steel spiral case, vertical Francis type and each is maximum rated at 28,250 HP, under 324 ft. net head, speed 277 RPM.

With a structural height of 456 feet, a base width of 2,650 feet and a crest length of 1,350 feet the Anderson Ranch Dam contains nearly 10,000,000 cubic yards of earth and rock. The reservoir behind the dam will hold 493,200 acre-feet of water.

When you consider turbines for your power project (whether it is a new installation or the expansion of an existing installation) we ask you to keep in mind the services which are offered by Leffel. Our 92 years of experience, our large modern plant, our thorough workmanship — all are ready to serve you.

1083

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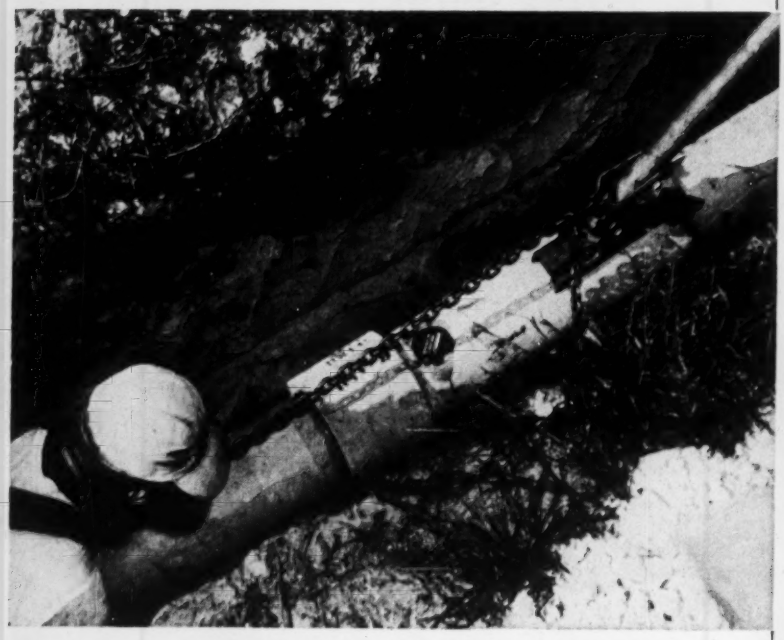

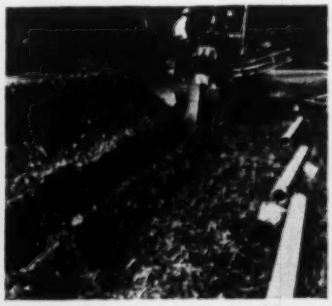

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**On this Utah** job, snow, ice and frozen ground caused no installation slow-down.

**In this California** installation, flexible Ring-Tite joints permitted conformance to curves.

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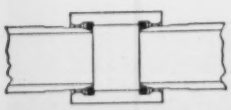
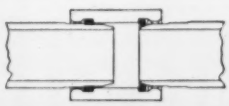
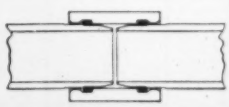


**A.** Rubber rings popped into grooves before assembly.



**B.** Lubricated pipe slides in under rubber rings.



**C.** Both pipes in assembled position. Rings compressed and locked in place.

**Johns-Manville TRANSITE PRESSURE PIPE**
AN ASBESTOS-CEMENT PRODUCT

# Treacherous soil made SAFE in deep cut in fine wet sand

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For a quarter of a mile the cut was 25 ft. deep in extremely light and fine sand, with little cohesive quality of the particles.

Ground Water at subgrade, and excavation into the wet material caused continuous sloughing of the dry soil above.

So the contractor installed a Stang Wellpoint System . . . the cut was quickly and economically stabilized . . . and pipe laying proceeded at a normal rate.

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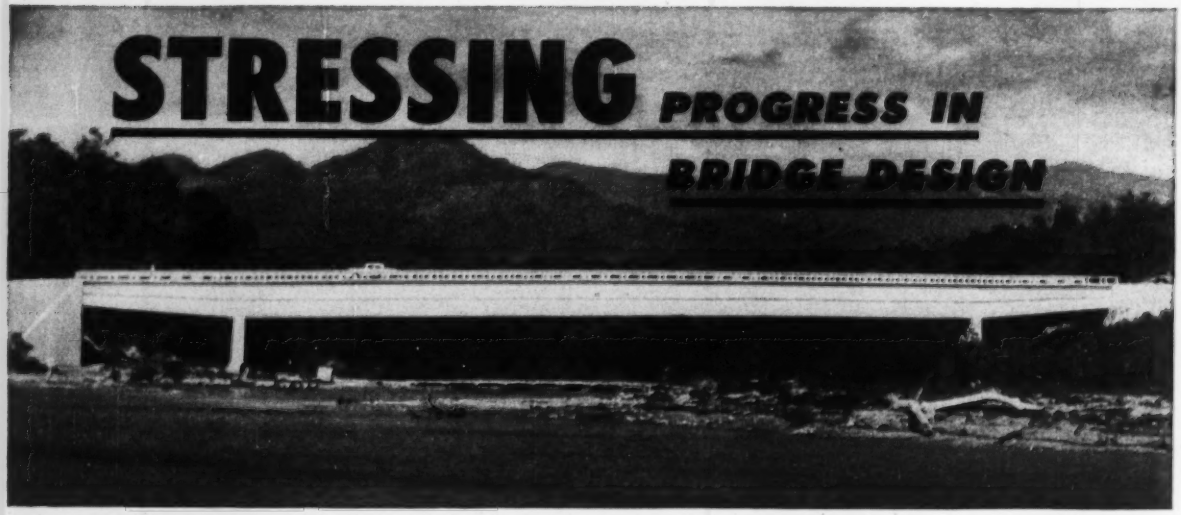
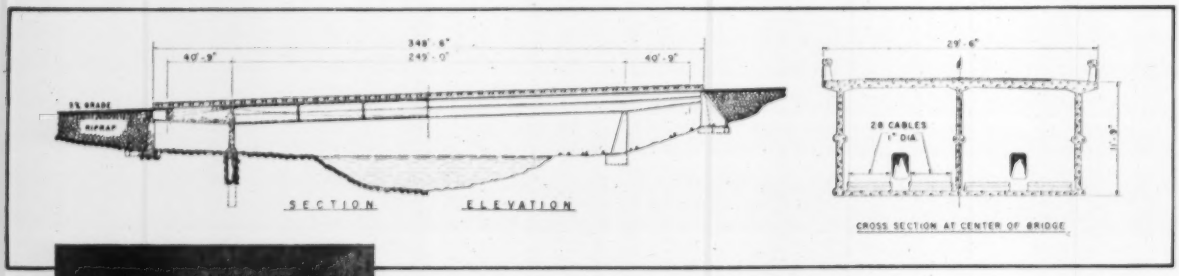
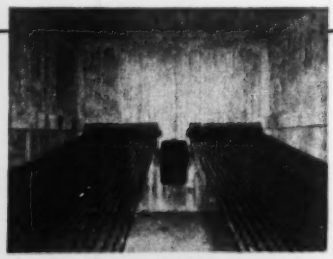
# STRESSING PROGRESS IN BRIDGE DESIGN



## Cuba's Cañas River Bridge Features Prestressed Reinforced Concrete Two-cell Box Girder, with 249-ft. Clear Span



● For low maintenance costs, concrete was selected for this bridge over the Cañas River, on the highway along Cuba's south coast between Trinidad and Cienfuegos. For utmost economy, the Republic of Cuba selected post-tensioned concrete.

This new bridge is said to be the longest clear-span, prestressed, reinforced concrete bridge in the Americas, and third longest span of its type in the world. The center span, 249′ in length, is of two-cell, hollow-girder construction. Width overall is 29′6″, and each cell is 11′9″ x 13′5″. The structure carries a 19′8″ roadway and two sidewalks, each 4′11″ wide.

Each hollow-box girder is post-tensioned against solid concrete anchorages 40′9″ long, by means of 28 one-inch cables. The load is transmitted through steel bearing plates, with take-up bolts which are accessible through inspection chambers in the end spans.

Soundness of the prestressed design and its practicability from a construction standpoint are evidenced by this slim, graceful structure which bespeaks quality in every line.

**CAÑAS RIVER BRIDGE**
on Trinidad-Cienfuegos Highway, Cuba

Designed by
**STRUCTURAL SECTION,**
**COMISIÓN DE FOMENTO NACIONAL;**
**ING. LUIS SAENZ,** Chief Engineer

Contractor: **CÍA CONSTRUCTORA AEDES**

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# CIVIL ENGINEERING

APRIL 1954

*THE MAGAZINE OF ENGINEERED CONSTRUCTION*

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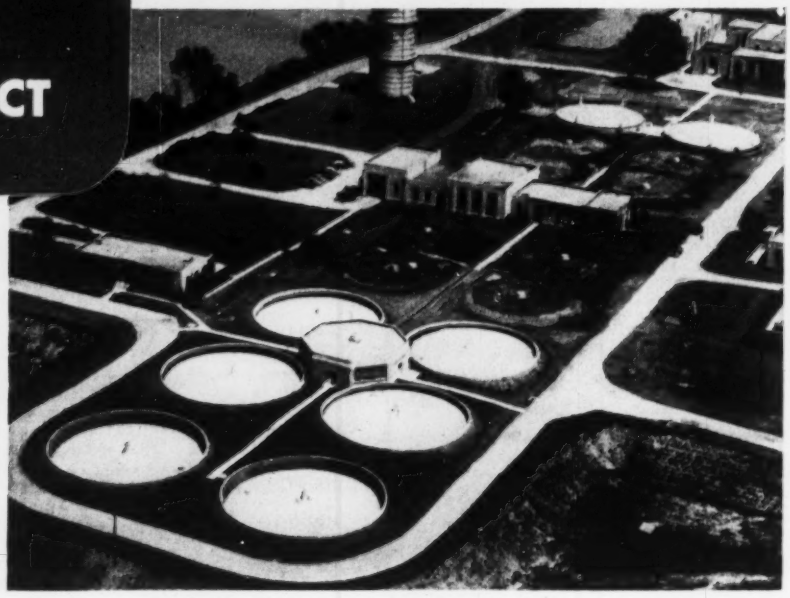
# ACCELERATED SLUDGE DIGESTION NOW A FACT

## at the Columbus, Ohio Sewage Treatment Works



**CRP**

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The Catalytic Reduction Process* has been installed at the Columbus, Ohio Sewage Treatment Works. The Process has increased digester capacity. For treatment plant expansion in the near future, it will not be necessary to build additional digesters. The Catalytic Reduction Process applied to one 70′ tank at the Columbus plant increased total digester capacity by the equivalent of three tanks.

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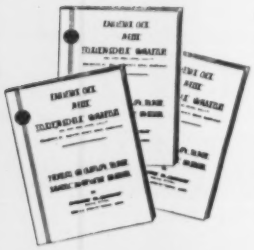
Originating in 1946, the Process was developed, tested and verified over six years on both laboratory and pilot plant scale. The results obtained in the pilot plant operation have been proven in full scale plant operation at the Columbus, Ohio installation.

The Catalytic Reduction Process is now available for consideration by consulting engineers for application on plants under design and for plants requiring expansion.



*Reprints of the paper by Professor P. F. Morgan on the development of this Process, and a paper by Mr. James H. Blodgett on the Columbus installation are available on request.*

**The only proven Process for accelerating biological digestion. (Patents applied for.)*

**The Catalytic Reduction Process is offered through the Catalytic Reduction Co., Inc. a subsidiary of the Chicago Pump Company.**

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CIVIL ENGINEERING

APRIL 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

L. L. BRINK, A.M. ASCE

Field Engineer, The Contracting Division,

Dravo Corporation, Pittsburgh, Pa.

Cellular steel cofferdams of 54-ft diameter are being removed following construction of new land wall, seen at left of cell being pulled. Note closeness to excavation of main-line and yard railroad tracks. Upper gate recess in middle wall appears in right foreground.

# Construction difficulties overcome in completing Monongahela Locks No. 2

The second and final phase in the reconstruction of Locks No. 2 on the Monongahela River near Pittsburgh, Pa., was completed and opened to traffic on November 18, 1953, after overcoming several challenging construction problems. This second phase consisted of the construction of the landward and larger of the two new locks, the riverward lock having been completed in the first phase in June 1951. For a description of this first part of the project see the article by Wilfred Bauknight in CIVIL ENGINEERING for September 1951.

Both phases were handled for the Army Corps of Engineers, Pittsburgh District, by the Contracting Division of Dravo Corporation. The bid price for the first contract was $7,263,136, and that for the second $7,967,667. The smaller of the two locks, the riverward one, is 56 × 360 ft and carried all the river traffic during the construction of the landward lock. Locks No. 2, one of the busiest in the world, is a vital link in the transportation of coal, petroleum, scrap iron, and other material to industry in the Pittsburgh area.

The second phase of construction consisted of the construction of the land wall, gate sills, and floor paving for the 110 × 720-ft landward lock chamber, as well as the upper and lower guide walls. The overall length of the project, including the guide walls, is 2,600 ft. The new lock chamber will accommodate fourteen 1,000-ton barges and a towboat. The old lock could handle only four barges, involving added delays because of the necessity of breaking up the standard six-barge tows.

The principal problems confronting the contractor in the second phase of construction were: (1) instability of the bank material and the proximity of main-line railroad tracks; (2) maintaining in continuous operation the existing intakes and sewers within the construction area for nearby steel mills; (3) maintaining uninterrupted traffic flow through the previously completed small lock, and (4) inaccessibility of the site and lack of working and storage space.

The walls and gate sills of the landward lock, like those of the river-

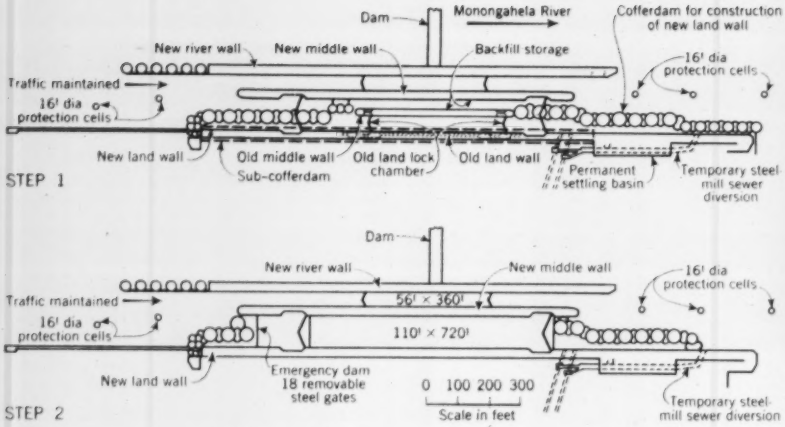



FIG. 1. In second phase of construction of Monongahela Locks No. 2, landward lock was built in two steps. Step 1 consisted chiefly of removal of old land wall and construction of foundation of new land wall. In Step 2, cellular cofferdam was remodeled to clear gate sills and emergency dam sill, and these areas were excavated to rock. Old middle wall and old lock paving were removed, lock chamber excavated to new level and new paving placed. (Riverward lock had been completed in first phase of construction under previous contract.)

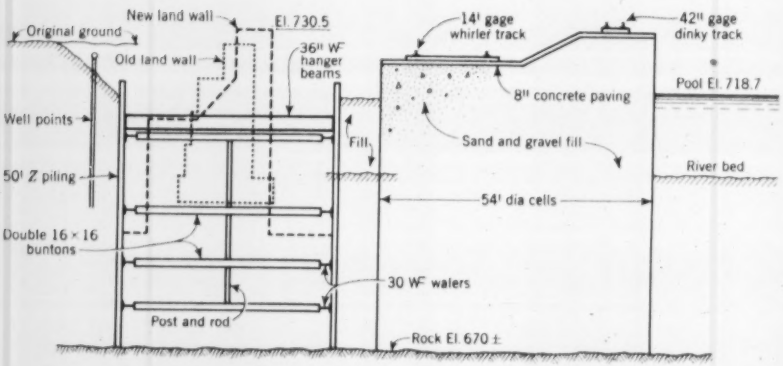
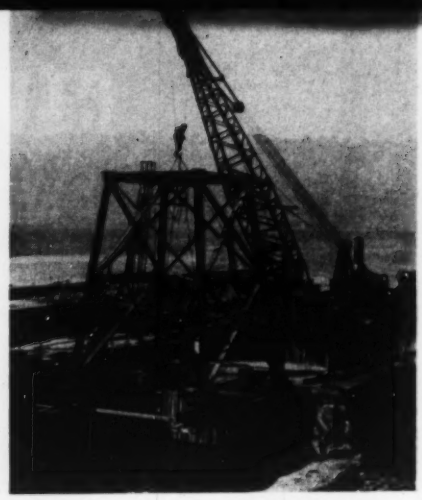
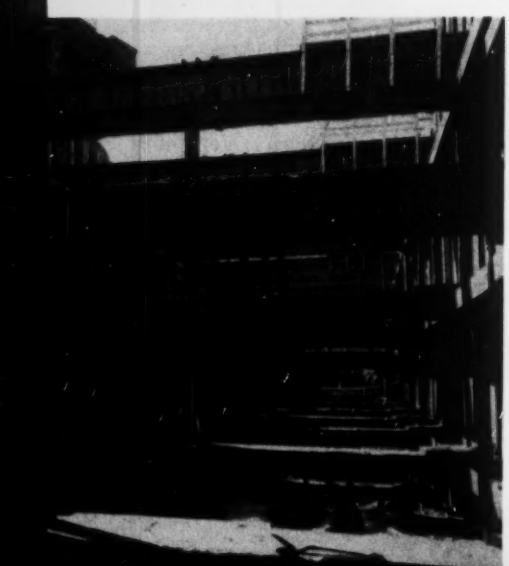



FIG. 2. Section through subcofferdam looking upstream shows bracing of buntons to provide wide working spaces. In photo, below, land side of subcofferdam is to right.



Gantry for whirler crane is being placed in 25 ft of water. Whirler will then be erected, ready for operation when cofferdam is pumped out. Partly removed old land wall is at right, old middle wall at left, and new middle and river walls at far left.



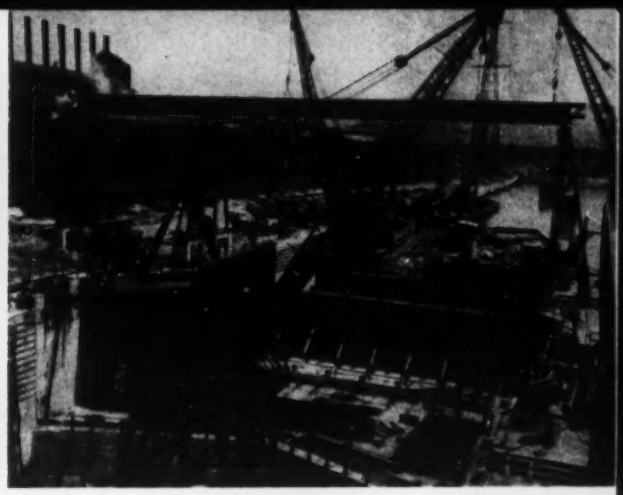
ward lock, are founded on rock approximately 50 ft below upper pool level. The lower guide wall is founded on steel bearing piles driven to rock, and the upper guide wall on steel sheetpile cells also driven to rock.

Construction of the landward lock was done in two steps, as shown in Fig. 1. As can be seen in the sketch, approximately half of the new land wall is superimposed on the location of the old land wall. In the first step, the old lock, on the land side of the old middle wall, was kept open for several months by the contractor for his own use in transporting excavated material, as will be explained later. Work done during Step 1 was the site excavation behind the old land and guide walls and simultaneous diversion of sewers, followed by the removal of the old land wall and the construction of the foundation for the new land wall, along with partial completion of the wall itself.

During Step 2 the cellular cofferdam was remodeled to clear the gate sills and the emergency dam sill. These areas were excavated to rock and the foundations poured. The old middle wall and the old-lock floor paving were removed. The lock chamber was then excavated to the level of the new-lock floor paving, which was then placed.

The single cofferdam layout, as shown for Step 2, could have been used for construction of the complete job, but the two-step construction was adopted for two primary reasons. One was that the new middle wall was not designed to withstand having the landward lock pumped out during flood stage. By leaving the old middle wall in place during Step 1, and filling the area between the old middle wall and the new middle wall with excavated material, the new wall was strengthened sufficiently to withstand water pressure to its top, which was 3 $^1/_2$ ft higher than the maximum which would otherwise have been permitted. This cut down the frequency with which the work area within the cofferdam had to be flooded to protect the middle wall. Storing of excavated material at this location also provided a convenient and economical source of backfill when it was required after completion of the

With new land wall completed in right foreground and under construction beyond, removal of old middle wall gets under way. At extreme left is new river lock in operation. This lock was constructed under previous contract and completed in June 1951.



Unique arrangement of 18 removable fabricated steel gates forms emergency dam just beyond upstream end of landward lock chamber. Gates are 11 × 12 ft and weigh 3 to 3½ tons each. They are handled by 10-ton hoist operating from 155-ft-long girder bridge of welded construction. Both gates and bridge were fabricated by Dravo's Engineering Works Division.

new land wall. The other advantage was that the old wall provided a means for supplying concrete and materials to the job, as dinkey tracks were laid along the top of the old wall, and extended both upstream and downstream along the top of the cellular cofferdam. Use of the new middle wall for this purpose was prohibited.

### Unusual cofferdam evolved

The landward embankment along sections of the new lock wall consists principally of a deep layer of wet plastic material. The existence of several mainline and mill-yard railroad tracks close to the wall made it necessary to build the landward wall in a cofferdam to a depth of 60 ft below track level and 57 ft below maximum river elevation. Because of the limited work area and the instability of the embankment, a rather unusual cofferdam design was evolved, as shown in cross section in Fig. 2. This cofferdam for the main land wall consisted of steel sheetpile cells of 54-ft diameter with connecting arcs on the river side, and an internally braced subcofferdam between the cells and the bank.

The subcofferdam varied in width from 37 ft 6 in. to 42 ft 6 in., and was 1,253 ft long. The heavy Z-sheetpiling and the large size of the wales and buntons, comprising the four bracing sets, allowed sufficient horizontal and vertical spacing between members for easy access for excavating, placing forms, concreting, etc. A well-point system was installed along the land side of the subcofferdam to partially drain the saturated embankment.

To brace the long, double 16 × 16-in. timber buntons or cross pieces in the subcofferdam, "hanger"

**Right:** Subcofferdam is seen partially constructed in view looking upstream. Cofferdam work was started near upstream and downstream ends, the middle part being finished last. Old land wall was removed as cofferdam progressed.

**Right:** Lock-floor paving 1 ft thick is placed opposite gantry-mounted whirler, as seen from completed land wall looking downstream.

beams were placed across the top of the cofferdam at each row of buntons and, by a system of rods and posts, all the buntons in each row were stiffened vertically. The buntons were bolted and keyed together and placed with their largest dimension in a horizontal plane so that no stiffening was necessary in this direction.

The middle wall of the old locks was used for part of the main cofferdam and for dinkey tracks to carry concrete and materials the length of the job during the first step of construction. Because the old lock chamber paving was 33 ft below the top of the new walls, two whirler cranes had to be mounted on gantries to command this area. After completing the new wall, the gantry cranes were ramped down to the elevation of the new lock floor to finish the excavation, pave the floor, and erect the lock gates.

Two 4 × 6-ft sewers from a nearby steel mill, carrying 90 mgd, emptied into the main cofferdam area. For these sewers, the contract included construction of a settling basin, which was incorporated into the design of the lower guide wall. (See Fig. 1.) Because the sewers had to be maintained in constant service, the downstream end of the lower guide wall and the settling-basin back-wall were constructed first in separate cofferdams, as a part of the first step of the work (Fig. 1). A recess was left in each for a temporary conduit 7 ft square.

Meanwhile, a manhole was constructed around each of the live sewers. These brick sewers were approximately 50 years old, and the mortar was in poor condition. During construction of the manholes, the side walls of the sewers had to be supported by wood lagging backed up by steel wales. The bottom was supported by flat steel channels hung from 24-in. WF beams by long rod bolts. The channels were installed one at a time, making the tunnel under the sewer as small as possible so as not to cause its collapse. After each channel was installed, its supporting rods were immediately tightened. When the manholes, guide wall, and back wall of the settling basin were completed, the sewers were diverted around the main cofferdam wall through the temporary 7-ft conduit by means of a series of bulkheads.

To facilitate the movement of all tows through the small river lock, and to protect Dravo's construction fleet from this continuous traffic, five steel sheetpile cells 16 ft in diameter were constructed at strategic positions along the approaches. The necessity for these sheetpile cells is evidenced by the fact that two were so badly damaged by tows maneuvering in and out of the lock that they had to be replaced, and approximately half of all the sheetpiling used in them had to be scrapped.

No preference was shown the contractor in the use of the river lock during the construction of the land lock. Since it was necessary to transport all the excess and unsuitable excavation material upstream to a designated disposal site in the river, the old land lock was kept in operating condition by the contractor for several months while all possible site excavation was performed. During this time part of the cellular cofferdam was being constructed, leaving an opening for access for the towboat and dump scows. Excavated material was loaded into dump scows and towed to the disposal area by towboat. By keeping the old lock functioning for his exclusive use, the contractor was able to proceed continuously with the excavation, avoiding the costly delays that would have resulted if the tows had had to wait their turn to use the new river lock.

The only land access to the site was a narrow road through the property of an adjacent steel mill. This fact, plus the almost complete lack of working space, made the use of a floating plant mandatory. Cement, sand, admix, and six types of coarse aggregate had to be delivered to the site in barges in sufficient quantities for continuous pouring. Practically all the embedded metal and structural steel for the job were also delivered in barges and, when necessary, stored in them for future use.

Concrete was supplied by a mixer boat, equipped with two tilting drum mixers of 2-cu yd capacity each. Aggregates were fed from barges to the bins above the batching plant by a whirler mounted on the stern of the boat. Cement was blown from the cement barges to the silo at the batcher. All batching operations were electrically operated and interlocked for accurate proportioning of the mix. Cement weights for each batch were automatically recorded.

Concrete was loaded from the mixers into 2-cu yd buckets, which were transported by dinkey cars to the monolith to be poured. Originally the dinkey tracks were laid on the main enclosing cofferdam and extended the full length of the lock wall. After the land-wall footing was completed, the tracks were relocated on it at the level of the lock chamber floor. Concrete for the upper guide wall was transported either by truck or by a combination of dinkey and towboat. Concrete was placed by the five rail-mounted, or three gantry-mounted whirler cranes, except that smaller and less accessible pours were made by derrick boats or crawler cranes.

The total volume of concrete used for the land lock was approximately 100,000 cu yd. The new land wall alone is as high as a five-story building, or 60 ft above its rock foundation. It is 42 ft wide at its base and 1,250 ft long. Beyond it, the guide walls extend 873 ft upstream and 485 ft downstream.

Completion of these locks marks another step in the Corps of Engineers' overall plan for the improvement of navigation facilities on the Monongahela River.

E. P. Daugherty was resident engineer for the Corps of Engineers. For Dravo Corporation, R. A. Thompson and the writer were respectively superintendent and engineer.

First tow to enter new landward lock, November 18, 1953, moving upstream, consisted of twelve 1,000-ton coal barges pushed by U.S. Steel Corporation's sternwheeler *Homestead*. This tow would have had to be broken into four parts to pass through old lock.

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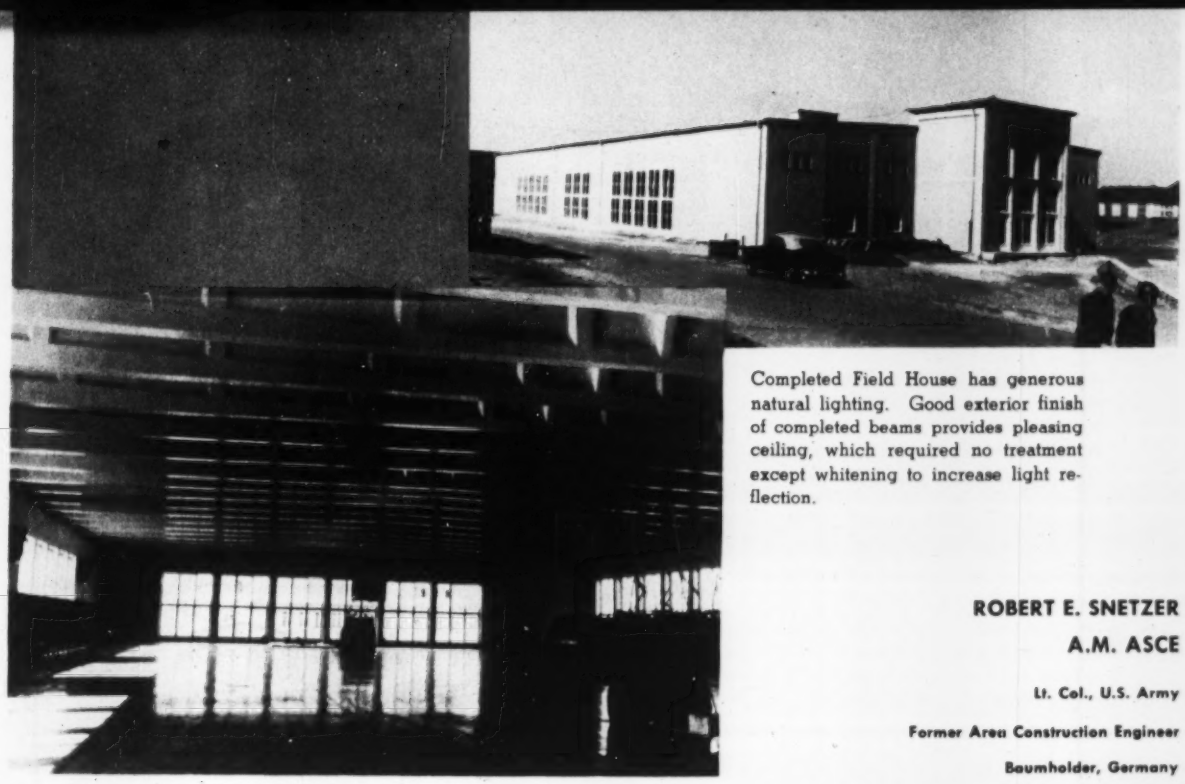

Completed Field House has generous natural lighting. Good exterior finish of completed beams provides pleasing ceiling, which required no treatment except whitening to increase light reflection.

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# Long-span prestressed-concrete beams used in Army field house

A field house built in Germany for American troops stationed there employs an interesting type of long-span prestressed concrete beam not commonly found in the United States. Several large contracting firms were asked to submit proposals on the construction of this field house, guided by the main requirement, which was for a clear open playing space 100 by 180 ft with a minimum clear height of 20 ft. No requirements as to type of design or method of construction were laid down, and other details which were specified have no bearing on the design of the 102-ft prestressed beams here described. Each contractor submitted a different solution for the spanning problem, including cable-tied arches, steel and concrete rigid frames, steel trusses, and prestressed concrete. No design employing wood in any form was submitted although its use had not been prohibited.

Analysis of the proposals submitted revealed that the prestressed-concrete beam design was by far the most favorable as to cost, utility, and appearance. The firm submitting this proposal, Peter Bauwens of Cologne, had considerable experience in this type of construction, having designed and built more than 90 such beams (although of shorter span) since 1949. As a result of these considerations this firm was awarded the job.

The field house itself is of simple construction employing reinforced-concrete columns with concrete-block curtain walls or glass windows spaced 8 ft 2 in. apart. There are 22 prestressed beams, each resting on two concrete columns to span the 102-ft narrow axis of the building. Lightweight precast-concrete roof slabs rest directly on the upper flanges of the roof beams.

The roof beams (Fig. 1) are of typical I-beam section with top flanges $15^{3}/_{4}$ in. $\times$ $7^{7}/_{8}$ in. and bottom flanges measuring $12^{5}/_{8}$ in. $\times$ $9^{1}/_{2}$ in. at the center. The overall depth of beam is 5 ft 3 in.

The top flange has a rise of 2 ft 3 in. above the ends to give the final crown to the roof. The bottom flange has a combined rise and camber of $9^{3}/_{4}$ in. The web thickness at the thin sections is $4^{3}/_{4}$ in., while at the ends and at the stiffening sections, which are spaced 9 ft 5 in. on centers, the web is the same thickness as the width of the bottom flange. The total overall length of the beam is 102 ft 6 in., actually 31.22 meters. It should be pointed out that all the original dimensions were in metric units.

All 22 of the beams were cast in succession in an area which was a direct prolongation of the building area, and in the same relative position as their final position in the building. Ten individual concrete foot-

Precision-built all-welded steel form was stripped 24 hours after pour began, and one beam was poured each day. Footing for next beam to be poured is at right. Beams were prestressed about 7 days after pouring and erected 3 days later.

Steel carrying truss was fabricated for lifting beams, since the extreme limberness of these long thin sections would not permit them to be picked up at ends alone. Beams were raised about 30 ft and moved laterally 200 ft by two stiff-leg cranes on rails.

ings were first poured on which to form the beams. These footings were not level, as the site was on the side of a hill with a difference in elevation of more than 10 ft between one end of a beam and the other. Footings were of course accurately built on the slope to give the proper final shape to the completed beams.

A precision-built all-welded sectional steel form was used for casting the beams. This form was unusually rigid, could be assembled and disassembled rapidly, and was used for all the beams in succession. The interior surface was smoothly finished and well greased, resulting in an excellent exterior finish on the completed beams. Ten electric vibrators were mounted on the outside of the form to assist in securing a dense, solid concrete as the pours were made. In addition, two interior-type vibrators were used.

Two rectangular-shaped 6-in. × 2-in. steel-shell "sword" forms were placed inside the form for its full length, to form the hollow spaces in which the prestressing wires would be placed after the concrete had set. These sword forms were withdrawn from both ends of the beam soon after pouring was completed to prevent their becoming rigidly lodged in the concrete. They were level throughout the length of the beam. At the ends they were placed 11 in. above the lower face of the bottom flange, but at the center, because of the camber, they were only $2\frac{1}{2}$ in. from the lower surface of the beam.

A high-grade fast-setting portland cement was used with sand and three different sizes of dense crushed-rock aggregate. The water-cement ratio was 0.32. Plastocrete, an admixture, was added for increasing the workability of the mixture. The designed ultimate compressive strength of this mixture was 6,410 psi at the end of 28 days, and actual test cubes showed an average strength of 7,000 psi at the end of seven days. Concrete was mixed in a $\frac{1}{2}$-cu yd electric-driven mixer with an automatic water feed.

The steel used for prestressing the beams was a special tempered prestressed reinforcing-steel wire with an ultimate tensile strength of 235,000 psi. Its allowable design stress under

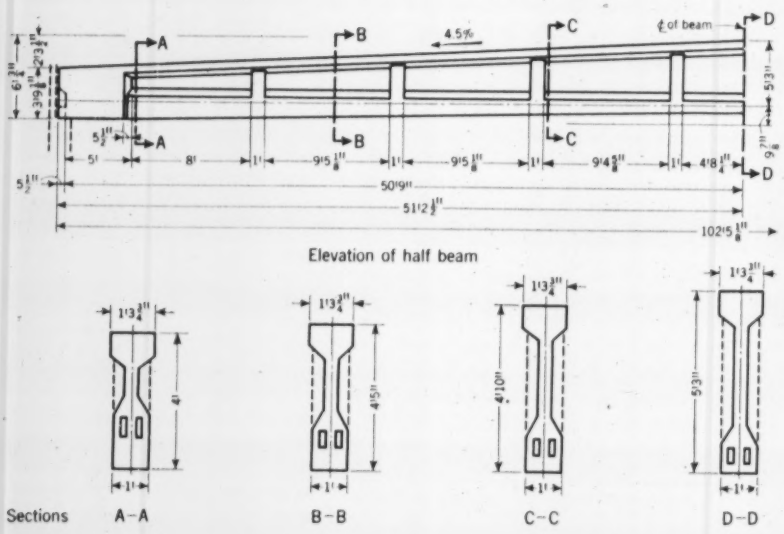
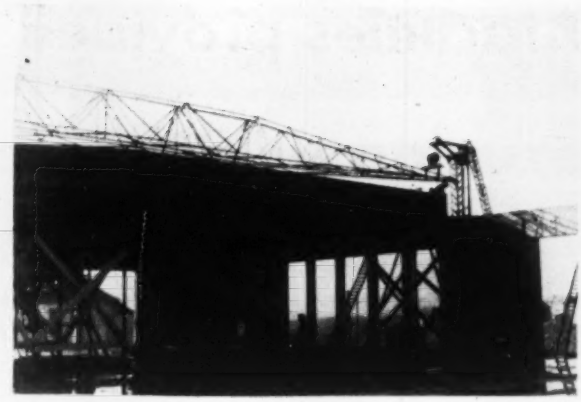
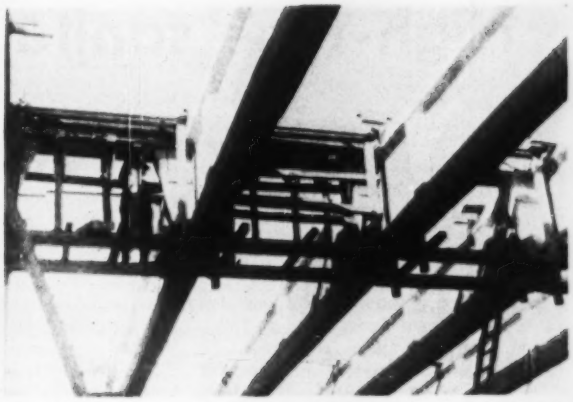



FIG. 1. Elevation and cross sections of roof beam indicate position of prestressing wires, which at ends are 11 in. above lower face of bottom flange, but at center, because of camber, are only $2\frac{1}{2}$ in. from lower surface of beam.



Carrying truss, just removed from prestressed roof beam following its placement in building, will be reused to transport next beam. Roof consists of 22 such beams resting on concrete columns to give playing space 100 × 180 ft with minimum clear height of 20 ft.



At center of span of roof beams, concrete U-bent will be cast in place to hold beams rigidly in position. Beams have length of 102 ft 6 in., depth at center of 5 ft 3 in. Lightweight precast-concrete roof slabs will rest directly on upper flanges of beams.

the method of end restraint employed was 135,000 psi. A total of 112 of these 5-mm (approx. 0.197 in.) round wires were placed in each beam. Fifty-six strands were bundled together and inserted in the slot formed by each pair of plate sword forms. The total steel cross-section per beam amounted to 3.42 sq in., and the total weight of steel was 1,181 lb.

The total dead load of the completed beam was 27 tons, and the permanent load of the roof, 9.28 tons per beam, with an additional snow load of 5.82 tons per beam. Under these conditions the stress in the prestressing steel is 122,000 psi.

Pouring of the beams began on the site at about the same time the walls were started. The operation was so planned that one beam could be completed each day. Three hours were required to assemble the steel form on its concrete base, and two hours to complete the pour for one beam. According to the temperature, one to two hours after the pour, the sword forms were withdrawn. The forms themselves were stripped 24 hours after the pour began and the cycle was repeated. When the compressive strength of the test cubes had reached a minimum of 4,700 psi, which was generally in seven days, the beams were ready to be prestressed. Three days after a beam had been fully prestressed, it was ready to be erected.

The Magnel method of prestressing was employed, two wires being stressed at a time and anchored by sandwich plates. Hand-operated hydraulic jacks were used at each end of the beam on the same pair of wires to equalize the elongation from the center outward. The reinforcing wires stretched an average of 5 in. upon stressing. Upon full stressing, the camber in the beams was increased sufficiently so that the center of the beam was raised off the footing approximately 2 in. In addition, the beams under tension were so limber that a man could easily stand at the center of a beam and move it back and forth.

### Erection difficulty overcome

This limberness caused some unexpected difficulty in erection and resulted in the loss of one beam through overturning when the first attempt was made to pick it up and move it into position.

To move the beams, crane rails were laid parallel to the length of the field house on each side and continued the length of the fabrication area. A short, stout, stiff-leg crane was mounted on these rails at each end of the beams and was used to raise them with a special sling and then move the length of the building and set them in final position. However, the crown in the upper flange of the beams, the camber in the bottom flange, and the extreme limberness of these long thin sections would not permit them to be picked up at the ends alone, with no intermediate support.

The solution was the fabrication of a pair of lightweight steel trusses the length of the beams. These trusses, laid in a horizontal position with only enough vertical trussing to enable them to support themselves, were bolted on each side of the beam to be raised. They thus formed a steel carrying truss which prevented sway and movement in the beam. With the aid of this erection device, no further trouble was experienced in raising the beams approximately 30 ft in the air and moving them 200 ft into final position. When a beam reached final position, trusswork and carrying sling were quickly removed and used to lift and place the next beam.

After all the beams were in place, a rigid U-bent of reinforced concrete was cast in place along their centers to rigidly fasten them together. The addition of the concrete roof furnished additional stability.

It was only necessary to whiten the already smooth surface of the beams to increase their light reflecting qualities and give a very pleasing effect to the ceiling of the field house. The very flat, arched, shallow beams give a maximum of unobstructed floor area with a minimum of the waste headroom commonly found in great arched field houses. Further, this type of construction uses the minimum amount of steel, which is acutely scarce in Germany, and makes maximum use of concrete and manpower, both of which are plentiful.

# High-type sanitary facilities provided in Venezuelan wilderness

Discovery of extensive iron ore deposits in eastern Venezuela, and the development of these resources by the U. S. Steel Corporation, touched off a host of large-scale engineering enterprises in the area. The stories of the Orinoco Mining Company's development of the mountain of iron ore known as Cerro Bolivar, construction of the 90-mile railroad to the port on the Orinoco River, the port facilities, and the dredging of the Orinoco-Macareo Waterway, have been well told in CIVIL ENGINEERING (December, 1953).

Because of the remoteness of both mine and port, the Orinoco Mining Company has provided complete towns at each of these locations for all personnel. These towns are Puerto Ordaz, the ore-loading port on the Orinoco River, and Ciudad Piar, the town located adjacent to the ore mountain, Cerro Bolivar.

Populations to be served were based on the experience of the oil companies in the western part of Venezuela, that is, about 4 persons per staff employee and 6 persons per employed worker in the company town, and 8 persons per employee in the adjacent residential community which it is expected will grow up around the outskirts of the company town. Facilities were designed for the populations given in Table I.

Most facilities were designed for a development based on the shipping of 5 million tons of ore per year. However, structures difficult to enlarge were based on the shipment of 10 million tons per year. Domestic water requirements were established at 50 gal per capita per day, with an additional 35 gal for the industrial area at Puerto Ordaz and 15 gal for the mining area at Cerro Bolivar. Water requirements for lawn sprinkling are about 0.2 in. per day. Thus sprinkling, where provided, requires an additional 35 gal per capita per day in the areas where Type A (row-type) housing is provided, and an additional 500 gal for the Type C housing area, where lots run to about a half acre each. The maximum daily consumption was assumed to be 120 percent of the average, and the maximum hourly flow, 272 percent of the average. Water requirements for fire protection were established at 500 gpm over a 4-hour period in residential areas and 1,000 gpm over a 4-hour period in industrial areas.

Sewage flow was estimated to be 50 gal per capita per day, with a maximum of 125 gal per capita per day. In addition, allowances for infiltration were made in certain areas at the rate of 20,000 gal per day per mile of sewer. Storm drainage systems were designed for the carry-off of a 2- to 5-year storm in residential areas and a 10-year storm in industrial areas.

Initial field investigations were made at the port and mine areas in the fall of 1950 to locate and evaluate sources of water, and needs for sewage treatment and drainage. Gagings were initiated where necessary. Laboratory studies of water treatment were made to assist in choosing sources of water and methods for water purification.

Rainfall data were meager, except at Ciudad Bolivar, where a 29-year record indicated an average of 40 in. per year. Short-term records at Cerro Bolivar indicate a somewhat higher rainfall there. However, less than 5 percent of this annual precipitation occurs during the dry season, which extends through January, February, and March.

Some twenty years of gaging the Orinoco at Ciudad Bolivar have shown it to have a minimum flow exceeding 250,000 cfs. Recent studies for a proposed federal hydropower development on the Caroni River have indicated a minimum flow in excess of 15,000 cfs. Other rivers in this region drain small areas, are virtually dry in the dry season, and carry raging torrents in the rainy season. Flow data on these had never been collected, and estimates of stages were established with the aid of judicious interviewing of local residents.

**TABLE I. Populations for which sanitary facilities were designed**

| | Immediate development | Development for 5 million tons of ore per year | Development for 10 million tons of ore per year |
|---|---|---|---|
| Puerto Ordaz: | | | |
| Company town | 1,740 | 3,040 | 3,810 |
| Adjacent community | 2,780 | 4,670 | 6,260 |
| Total | 4,520 | 7,710 | 10,070 |
| Ciudad Piar: | | | |
| Company town | 1,210 | 2,170 | 3,430 |
| Adjacent community | 1,860 | 3,190 | 4,990 |
| Total | 3,070 | 5,360 | 8,420 |

### Water supply at Puerto Ordaz

With adequate water at Puerto Ordaz in either the Orinoco or the Caroni River, the question of quality was investigated. The Orinoco is relatively turbid and low in color while the Caroni is clear but more highly colored. The more significant chemical characteristics are:

| Characteristics | Orinoco | Caroni |
|---|---|---|
| pH | 6.9 | 5.9 |
| Alkalinity, ppm (as $CaCO_3$) | 14 | 2 |
| Chlorides, ppm (as NaCl) | 2 | 2 |
| Color, ppm | 40 | 100 |
| Turbidity | High | Low |
| Iron, ppm | 1.7 | 1.2 |
| Hardness, ppm | 17 | 5 |

Both waters are amenable to coagulation with alum. Because of its extremely low alkalinity, the Caroni water requires the addition of alkalinity for coagulation at all times. It is somewhat more difficult to treat and requires substantially more alum than Orinoco River water. This, among other reasons, contributed to the decision to take water for Puerto Ordaz from the Orinoco.

The water is pumped from the river to a treatment plant, whence the treated water is pumped through a transmission main to the distribution system, divided into high-level and low-level service areas. The high-level service area, containing all staff housing, is provided with a 150,000-

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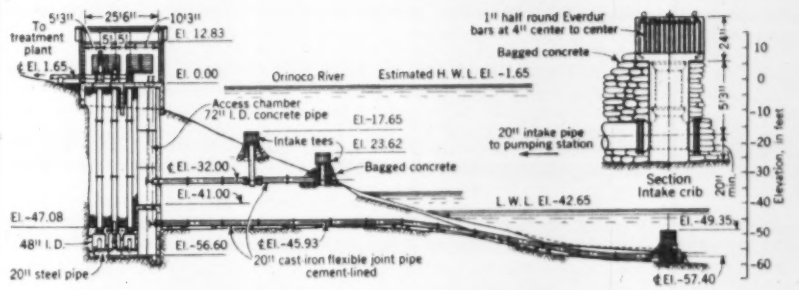



FIG 1. Water supply at Puerto Ordaz is taken from Orinoco River through three intake cribs to facilitate quality selection with the 40-ft variation in river stage. Wet well common to all three cribs is connected by 20-in. header to bottom of pump wells.

gal elevated storage tank. The high-level service feeds a 400,000-gal ground storage tank which serves the low-level service area. In addition, there is a separate connection to the low-level area from the elevated storage tank by means of a pressure-reducing valve which opens when the pressure in the low-level area falls below 25 psi.

The distribution system consists of 3-in. to 16-in. cement-lined cast-iron bell-and-spigot pipe with lead joints. Standard 4- and 5-in. hydrants are used, with drain openings plugged. Tropical-type hydrants were considered but the post type was found more economical. Copper service pipe connections were installed when the mains were laid. Each service is metered, the meter being located in a concrete box with a cast-iron lock cover.

The Orinoco River varies almost 40 ft in stage. To minimize difficulties from this varying stage, and to assure a continuous water supply, intake structures are located at three levels (Fig. 1), the lowest of which will always be submerged by some 6 ft. This lowest intake is about 10 ft above the river bottom, to avoid drawing bottom sediment into the pump wet-well. Each of the identical intakes has openings covered with 1-in. Everdur bars spaced 4 in. on centers on the downstream side. Each intake is designed for 6 mgd, the ultimate capacity of the pumping station; at this flow, the velocity into the intake will be 0.545 fps.

The intakes feed into a common wet well of 6-ft diameter with an access chamber of the same diameter. A 20-in. header leads from the bottom of the wet well to the bottom of three pump wells. The pumping station has provisions for three 2-mgd motor-driven turbine-type well pumps, although only two are installed at present—one of 1-mgd and the other of 2-mgd capacity. The static lift for these pumps is 257 ft. The 2-mgd pump is provided with a diesel engine standby prime-mover in addition to its electric motor. The pumping station is unattended, as the pumps

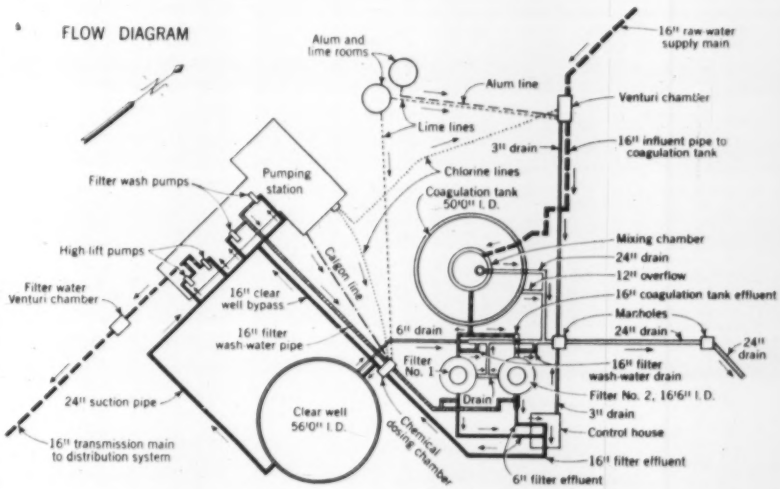



FIG. 2. Flow diagram shows arrangement of plant at Puerto Ordaz for treating Orinoco River water for domestic use. Capacity is 1 mgd.

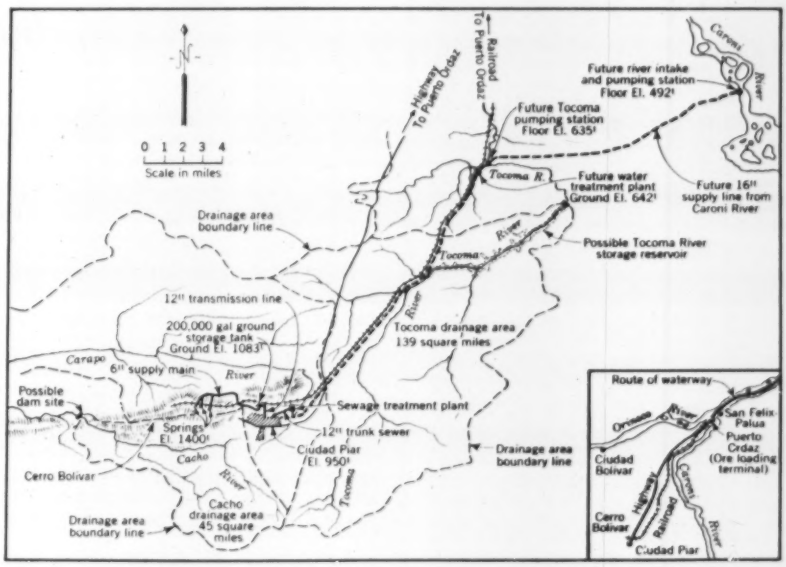
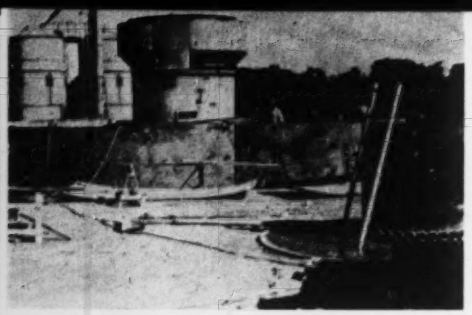
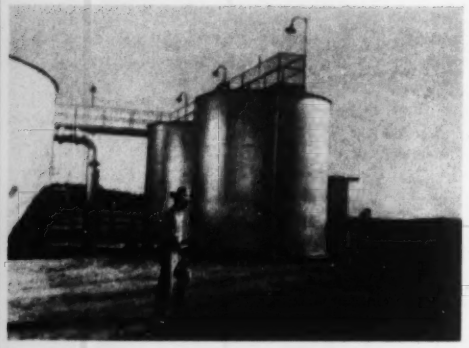
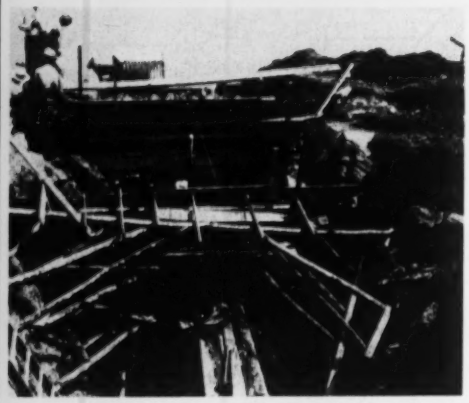



FIG. 3. Sanitary facilities at Ciudad Piar are influenced by fact that watersheds drain in all directions from iron-ore mountain, Cerro Bolivar. Nearby rivers are virtually dry in dry season.



Water treatment plant at Puerto Ordaz treats 1 mgd of Orinoco River water with provision for expansion in 1-mgd units to 4 mgd. "Tin-can plant," seen under construction above, consists of two filter tanks in foreground, coagulation tank beyond, and chemical bins in background. In view of completed plant, below, two filter tanks are at right.





Intake works on Orinoco River at Puerto Ordaz, here seen under construction, contains two pumps, one of 1-mgd capacity, the other of 2-mgd capacity. Pumps are operated automatically from treatment plant.

Transmission main carrying treated water to distribution system at Puerto Ordaz is 16-in. welded steel pipe laid on top of ground. Pipe is supported on saddles made from burlap bags filled with dry concrete. Rain furnished hydration water.

are operated by automatic control from the treatment plant.

An unusual feature of the pumping station is the inclusion of facilities for back-washing the pump screens. Each pump well is provided with a 24-in. outer casing and a 20-in. inner casing to which the screen is fixed. The screen is made of $^3/_8$-in. half-round bars, with $^3/_8$-in. vertical openings between them. When a pump screen is to be washed, water from the pump discharge header is applied to the inside of the inner casing, where it serves to back-wash the screen. The waste wash water is collected tangentially in the bottom chamber and conducted in a separate 12-in. pipe for discharge above ground level. A flap valve at the bottom prevents this water, with its debris, from flowing back into the wet well.

An auxiliary water line is run to the top of the waste pipe for backwashing the bottom chamber. Waste water from this reverse washing escapes up the 2-in. annular space between inner and outer casings and discharges just below the pump-house floor.

### Water treatment plant

The treatment plant at Puerto Ordaz (Fig. 2) has a capacity of 1 mgd, with provision for additional 1-mgd increments to an ultimate capacity of 4 mgd, for which the chemical feed and service facilities are designed. After passing through a venturi meter, the water is dosed with alum and, if necessary, lime and chlorine. The water then enters the top of the 12-ft-diameter center well of a 50-ft-diameter steel coagulation tank. From the center well, which serves as a flocculation chamber, the water is applied to the bottom of the main tank through a series of radial perforated transite laterals. The water rises vertically in this tank and the effluent is collected in peripheral channels around the center well and outside the tank shell. This clarified water enters two $16^1/_2$-ft circular steel gravity-type rapid sand filters, with 6-ft-diameter center wells for carrying off waste wash water. The filtered water passes through rate controllers and is dosed with chlorine, lime, and a phosphate-type corrosion preventive before it enters a 290,000-gal clear well. Thence high-lift pumps discharge it to the 16-in. welded steel transmission main to the distribution system. This transmission main is laid on top of the ground, supported on saddles made from burlap bags filled with dry concrete.

A system of separate sanitary sewers collects the sewage from Puerto Ordaz for discharge through three outfalls into the Orinoco and Caroni Rivers. Sewers are of concrete, manufactured in Venezuela, while outfalls are of cast iron with flexible mechanical joints; mechanical ball-joint pipe is used for underwater construction. Minimum sizes for laterals and house connections are 8-in. and 6-in., respectively. Manholes are of concrete block, with armored precast concrete manhole frames and covers. Storm sewers and culverts are of corrugated galvanized steel pipe, double full coated with a bituminous coating. Inlets are of concrete and concrete blocks with inlet gratings of precast concrete.

Because of the very great dilution available in the Orinoco and Caroni Rivers, sewage treatment is not necessary. However, to avoid local nuisance, all outfalls discharge about 20 ft below low water, with four outlets on the main 10-in. Caroni outfall to disperse the sewage.

### Water scarce at Cerro Bolivar

While the port area is amply supplied with water, the situation at Cerro Bolivar is totally different. Cerro Bolivar is at the summit of the several watersheds which drain in all directions from the mountain, as shown in Fig. 3. The rivers in the vicinity—the Cacho, Carapo, and Tacoma—are all virtually dry during the dry season. The nearest perennial stream is the Caroni, some 35 miles distant.

The Carapo, which has no site suitable for the construction of an adequate storage reservoir, has been designated to be the receiving stream for the sewage from Ciudad Piar. The Cacho has a suitable reservoir site, but with its limited drainage area, only 4.5 sq miles, and with the few runoff data available, there can be no certainty as to the yield that can be economically developed. In addition, surface drainage from the mining area flows into the Cacho and would affect the quality of its water.

Development of the Tacoma River by the construction of a 1,300-million-gal storage reservoir to collect runoff from a 139-sq-mile drainage area is feasible, but relatively expensive. Use of the Tacoma River during periods when its natural flow is adequate, supplemented with water from the Caroni River during drought periods, is also costly but requires much less land. For either plan a filtration plant is required.

Wash borings sunk in areas which appeared promising for the development of ground water indicated rock to be only some 11 ft below the surface. The overlying porous material

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is of insufficient depth to make development of shallow wells practicable. On the other hand, the iron-ore bodies on Cerro Bolivar itself are porous and serve as excellent catchment areas. Rain water percolates through the ore until it reaches impervious basement rock. It then flows laterally, coming out of the mountain side as springs. One of these springs was used for water supply for several years for the exploratory camp on Cerro Bolivar, and this spring and several others are known to flow the year round.

Gagings indicated that in March, at the end of the dry season, the larger springs yield 50 to 100 gpm each. It was estimated that careful development of three or four springs could provide the 300,000 gal per day required for domestic use at Ciudad Piar and the adjacent community. This does not include any allowance for sprinkling.

With increased need for water in the area and with diminished groundwater storage on account of mining of the ore, it may become necessary to go to the Tacoma and Caroni Rivers for a firm supply. Detailed plans and specifications for the necessary pumping stations, transmission main, and treatment plant have been prepared against such an eventuality.

Three springs have been developed on the north slope of Cerro Bolivar, about 300 ft above Ciudad Piar, by the installation of perforated cement-asbestos pipe collectors in trenches perpendicular to the direction of flow. The trenches are backfilled with gravel and sand. The intercepted water is collected in a concrete box, and conducted to a 200,000-gal covered steel ground storage tank near the foot of the mountain, about 100 ft above the town. This tank, and the transmission line from the tank to Ciudad Piar, can be utilized in the event that development of the Tacoma and Caroni Rivers becomes necessary.

The water is sufficiently clear to be used without coagulation or filtration. It is soft and surprisingly low in iron, most samples containing less than 0.5 ppm. The water does contain free carbon dioxide and is therefore somewhat corrosive. Chemical treatment, including chlorination to render it bacteriologically safe, the addition of soda ash to neutralize the carbon dioxide, and a phosphate-type corrosion preventive, is provided in a chemical building at the foot of the mountain. Water-operated solution feeders inject the chemicals into the transmission line in proportion to the flow. Proportioning is done from a compound 2 × 6-in. main-line propeller-type meter. The capacity of the meter is from 15 to 900 gpm, which makes it sensitive enough to measure flow and to proportion chemicals at extremely low flows and still large enough to pass fire flows through to the distribution system. Adequate contact time is provided in the main between the chemical building and the town.

The water distribution system, sewerage and storm drainage facilities for Ciudad Piar are similar to those for Puerto Ordaz, except that two small sewage pumping stations and a treatment plant are required for Ciudad Piar.

### Sewage treatment for Ciudad Piar

The streams in the vicinity of Cerro Bolivar are virtually dry at the end of the dry season. All the sanitary sewage from Ciudad Piar and the adjacent community is therefore collected in a trunk sewer and conveyed to a site on the Carapo River where it is treated in a high-rate trickling filter plant (Fig. 4).

Sewage is metered as it enters the plant and then flows through a manually cleaned bar screen into one of two manually cleaned 33-ft-long grit chambers. About 0.25 mgd of either the effluent from the filter or underflow from the final settling tank is metered and recirculated to the grit-chamber influent to prevent stagnation during periods of low flow. The sewage then enters a primary settling tank of 30-ft diameter, equipped with mechanical sludge and scum removal. Primary effluent flows to a dosing chamber which applies the sewage to a trickling filter of 40-ft diameter by means of a reaction-type rotary distributor. The dosing siphon will permit the distributor to operate satisfactorily during low-flow periods if the recirculation pumps are shut down.

Filter effluent flows to a 22-ft-diameter final settling tank equipped with mechanical sludge and scum removal. Provisions are available for chlorinating the final tank influent or the effluent before its discharge to the stream. The underflow of the final settling tank, containing the secondary sludge, is carried to the recirculation wet well whence it is pumped to the plant influent. Primary sludge, as well as scum from the two settling tanks, is pumped to a 30-ft-diameter unheated digester, with a floating cover. Digested sludge is drawn by gravity to sludge drying beds, while supernatant liquor flows to the recirculation wet well.

The plant is provided with a bypass and overflow line, which can carry screened sewage, primary effluent, or filter effluent directly to the river. Provision is made for chlorination of this bypassed or overflow sewage.

Sewage flow through the plant is entirely by gravity, and in the event of power failure the sewage would still be adequately treated and chlorinated, with only the recirculation and sludge pumps not operable.

The sanitary facilities described have all been placed in operation in the last few months. The successful cooperation of all the organizations concerned with the construction of the comprehensive Cerro Bolivar project, and the close integration of their efforts to meet difficult deadlines, was evidenced by the shipment of the first load of ore mined from Cerro Bolivar to the United States on January 9, 1954.

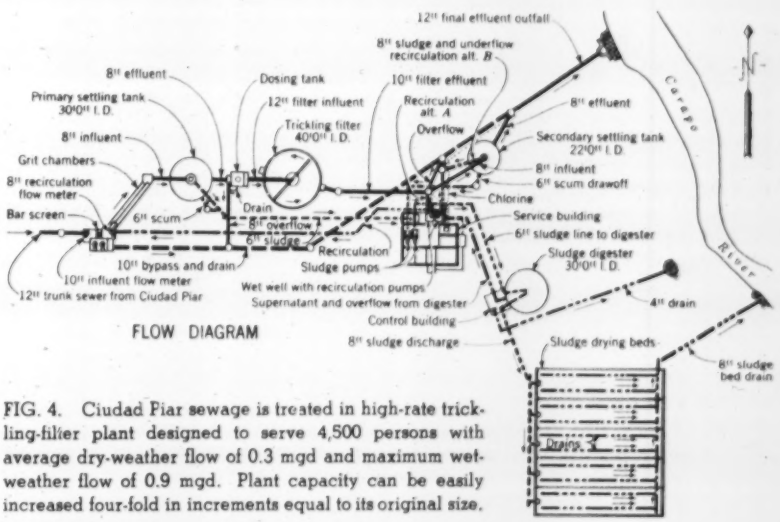



FIG. 4. Ciudad Piar sewage is treated in high-rate trickling-filter plant designed to serve 4,500 persons with average dry-weather flow of 0.3 mgd and maximum wet-weather flow of 0.9 mgd. Plant capacity can be easily increased four-fold in increments equal to its original size.

# Development of nuclear power for peaceful purposes

**HENRY D. SMYTH,** Member, U.S. Atomic Energy Commission, Washington, D.C.

The author, one-time chairman of the Department of Physics of Princeton University, was associated with the wartime Manhattan District of the U.S. Corps of Engineers until it was succeeded in 1947 by the U.S. Atomic Energy Commission. His "General Account of the Development of Methods of Using Atomic Energy for Military Purposes under the Auspices of the United States Government, 1940–1945," better known as the Smyth Report, is still available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C., at the price of 40 cents. A reading of it will add to an understanding of the following account of the status of the development of commercial power from nuclear fission, which Dr. Smyth first delivered before the Washington, D.C., Convention of the American Institute of Chemical Engineers, March 9, 1954.

Fifteen years ago a new natural force was discovered, the fission of uranium. Within the first two months of 1939 the idea of uranium fission was suggested, communicated, proved experimentally, and published. The speed and importance of this discovery constitute one of the most spectacular events in the history of science. It involved men of many nations, free communication, high imagination, and precise experiment.

We are now engaged in an effort to harness this same atomic energy for peaceful purposes. It is a great effort and indeed should be so, for success in it may materially change the lives and conditions of men. The accident of history has placed the major responsibility for this effort on the Government of the United States. As its agent, the Atomic Energy Commission has brought together an array of scientific and engineering talent never before equaled. Private industry already is carrying a major share of our enterprise under contract to the Government and is now becoming more and more active on its own initiative. This is as it should be.

Those of us engaged in this effort believe we shall be successful. We know that it will have many dead ends and wrong turnings and many dull and dreary stretches. The barriers to be surmounted or bypassed are formidable.

By now we think we know what these barriers are, what kinds of problems have to be solved if nuclear power is to be significant in our economy. We should know these problems, for it is now fifteen years since nuclear fission was discovered, ten years since the first large-scale nuclear reactor was started, and five years since the Atomic Energy Commission announced its first program of nuclear reactors aimed at power. Energy from nuclear power plants will be just like energy from coal-burning power plants. Except for special purposes, the sole criterion of comparison will be cost.

## General problems of a nuclear power reactor

Let me recall to you the three major facts of nuclear fission. They are: first, that enormous amounts of energy are released; second, that the products of fission are radioactive; and third, that fission is caused by neutrons and results in the production of further neutrons, thereby making a chain reaction possible.

These basic facts confront the designers of reactors with a series of technical questions which can be grouped in five general areas. These general areas which have to be considered are, first of all, what we call neutron economy; second, the effects of nuclear radiations; third, heat transfer or removal; fourth, control and instrumentation; and fifth, chemical processing of fuel both before and after it goes into the reactor. Let me go into some detail about these five areas.

**1. Neutron economy.** It is evident that the first requirement of a nuclear reactor is that the nuclear chain reaction shall occur. In other words, if a uranium nucleus in a structure containing uranium does undergo fission, it must produce neutrons in sufficient quantity to cause other nuclear fissions in the vicinity and to set up a self-propagating nuclear chain reaction. Actually the number of neutrons produced by a single fission is not very large. On the average, for every neutron used up in producing a fission, about two and a half new neutrons are released, a net gain of one and a half neutrons per fission. Unfortunately, from the point of view of neutron economy, all the neutrons produced in a single fission are not absorbed in uranium 235 to produce additional fissions.

There are, in fact, four things that can happen to the neutrons that are produced in the fission process. First of all, since neutrons are extremely penetrating, they may simply escape to the outside environment. A second way in which they disappear is by capture by uranium 238 without causing fission. A third possibility is that they may be captured by impurities in the uranium or by the structural materials that have to be introduced for cooling or other

purposes. The fourth possible process that can occur is, of course, the capture of neutrons by uranium 235 resulting in fission. If the fourth process produces more neutrons than are lost by the first three processes, the chain reaction occurs. Otherwise it does not. Evidently, in a given arrangement, the first three processes may have such a high probability that the extra neutrons created by fission will be insufficient to keep the reaction going.

One obvious way to reduce the probability of the escape of neutrons is to increase the amount of uranium present. The more uranium there is, the more likely it is that the neutrons will be absorbed in it and cause fission rather than escape. This leads, of course, to the concept of critical mass, which is familiar to many of you.

The second process we need to minimize is the capture of neutrons by uranium without producing fission. There are several things that can be done to minimize this process. Two of them depend on the great effect which the speed of the neutrons has on the probability of their absorption in uranium 238. This probability is reduced by using a slowing down material, called a moderator, and arranging the uranium in a lattice. Another way to reduce non-fission capture by uranium is to eliminate part or all of the uranium 238 isotope, since it contributes very little to the fission process and does absorb many neutrons. Of course, in the Hanford reactors, this was not desirable because one of the objectives of the Hanford reactors was to produce plutonium by absorption of neutrons in uranium 238.

To reduce the third process, the non-fission capture of neutrons by impurities or structural materials, requires that the uranium itself be very highly purified in the first place and that structural materials be used which have a low capacity for the absorption of neutrons. This last consideration puts many restrictions in the path of the designer of a nuclear chain reactor.

**2. Effects of nuclear radiation.** The effects of nuclear radiation have several aspects that the designer needs to keep in mind. Perhaps the most important one technically is the fact that the constant bombardment of structural materials and of uranium itself causes changes in their properties. A piece of uranium, a piece of steel or aluminum in a nuclear reactor is continually bombarded by neutrons, by gamma radiation, and to some extent by other nuclear radiations. The result of such bombardment may be a change of shape, an embrittlement, a change in thermal conductivity, or of almost any other property of the material. The rate of corrosion of a material is affected by the presence of nuclear radiation.

Nuclear radiation is dangerous to health. Consequently the whole reactor structure must be surrounded by a shield which will not be penetrated by the neutrons and other radiation. Radiation is present not only while the reactor is running, but induces a lasting radioactivity in the materials of the reactor. In particular, fuel elements in the reactor become highly radioactive, and when they are unloaded for chemical processing, they have to be handled by remote control. It is unsafe for any personnel to handle them directly. Similarly, maintenance must be held to an absolute minimum, and actual direct access of the operators to the heart of the reactor must be avoided.

**3. Heat transfer or removal.** The principal interest in establishing a nuclear reaction is because the fission processes release such enormous amounts of energy, millions of times the amounts of energy released in chemical reactions in corresponding amounts of material. To be sure, the Hanford reactors were not designed for the purpose of producing energy but for the purpose of producing plutonium. Nevertheless, the production of large amounts of energy is inescapably associated with the fission process, and therefore the designers of the Hanford reactors had to provide some means of removing that energy. It was a simpler problem for them than for the designers of a reactor intended to produce energy. The Hanford designers had merely to get rid of the energy [heat] in some way.

The designers of a power reactor must extract the energy in a form which can be put to use. Nevertheless, many of the problems are the same. They differ from ordinary heat transfer problems for reasons that have already been suggested: namely, that the choice of materials is limited by neutron economy, that corrosion effects may be enhanced by the radiation present, and finally that the replacement of parts is difficult or impossible because of the health dangers involved. In a power producing reactor, the temperature should be as high as possible so that the heat energy removed can be converted into useful power efficiently. This is a real difficulty as we shall see later on and is one point where the Hanford designers had a considerable advantage.

**4. Control.** When the first reactors were designed, the question of control was a very critical one. No one knew very certainly whether or not it would be possible to prevent the reactor from running away with itself. We do not want to have a reactor heat up to the point where it will melt and destroy itself. We wish to avoid this for two reasons: first, we don't want to lose the reactor; and second, we don't want to spew radioactive material all over the countryside. By now, we have had enough experience so that we are perfectly sure that we can build a reactor which we can control. There does remain, however, a problem of convenience, efficiency, and cost in designing the proper controls to start, stop, or maintain the nuclear chain reaction at a desired operating level.

**5. Chemical processing of fuel.** Ideally, we would like to put into a nuclear reactor a certain amount of uranium and leave it there until all the uranium had been converted into heat energy and fission products. If that were possible, we would be concerned with chemical processing only in preparing the fuel. Unfortunately, the difficulties both of neutron economy as affected by the growth of fission products, and of the corrosion or radiation damage of structural materials or fuel elements, make it quite out of the question to consume more than a fraction of a nuclear charge in any known design of reactor. After a certain length of time—and one of the problems in the design of reactors is to make that length of time as great as possible—it is necessary to remove the fuel. It is too valuable to throw away, since it will probably still contain some 90 percent or more of the fissionable material. Consequently, we have to reprocess it chemically, separating out the fission products, and refabricating the uranium into new fuel elements. This turns out to be one of the most costly processes in the whole business of operating a reactor for power.

It is possible that the nuclear power industry will stand or fall economically depending on the success which chemists and chemical engineers have in developing cheap proc-

esses for purifying and refabricating nuclear fuel.

### The Hanford reactors

For neutron economy, the Hanford reactors are large. They use graphite as a moderator, and the natural uranium fuel elements are arranged in a lattice. Both graphite and uranium are very highly purified. Cooling channels and protecting coatings of the uranium fuel elements are aluminum of minimum dimensions.

To shield operating personnel, the reactor is surrounded by heavy composite walls and all control and operation are from outside the shields. To reduce corrosion of the aluminum, the cooling water is purified and the temperatures held relatively low. To avoid corrosion or distortion of the uranium, it is canned in aluminum and not left in the reactor very long.

Heat is removed by large volumes of Columbia River water with a relatively low exit temperature. The water is then held in retention basins before returning to the river.

Control is by neutron absorbing rods that move in and out of the reactor. The position of the rods is recorded at the control desk and varied by the operators, or automatically in response to instruments.

Chemical processing by a solvent extraction process is done in a separate plant to which the fuel elements are transported in shielded railroad cars, with all operations remotely controlled.

Fundamentally, it is the low exit temperature of the cooling water and the short life of the fuel elements that make this plant impracticable as a power source.

### Breeding

Uranium 235 is the isotope of uranium in which fission occurs most readily. Unfortunately it is present in natural uranium only as one part to 140. Natural uranium is none too plentiful, and to be able to use only 0.7 percent of it is frustrating. Neutrons absorbed in the other uranium isotope, uranium 238, lead to the production of plutonium, and plutonium is readily fissionable. This fact early suggested the possibility that a reactor could simultaneously produce heat energy from the uranium 235 in natural uranium, and produce plutonium from the uranium 238, and that then the plutonium could be used as fuel for further production of energy. It was even suggested that the plutonium produced might be greater in quantity than the uranium 235 burned up. Such a process is called a breeding process, since more fuel can be produced than is burned.

This is of course a very fascinating idea. It turns out, however, that it may not be so very important whether actually more material is produced than is burned. It is obviously possible to produce some plutonium, since that is what the Hanford reactors are for, and it should be possible to take that plutonium and use it as fuel for power reactors. Whether the amount of plutonium produced is slightly less or slightly greater than the amount of uranium 235 burned up is not very important.

We do, however, make a distinction in nomenclature whereby we call a reactor that produces plutonium in smaller quantity than uranium burned a *converter* and one where the quantity produced is greater than that of uranium burned a *breeder*. In either case, it should be possible eventually to convert the fission energy of both isotopes of uranium to useful power. In the case of the converter, there would be some loss; in the case of the breeder, the losses in the reactor would be zero, but in either case, there will be losses in chemical processing so that the difference is not very significant. The difference, however, between using just the uranium 235 and eventually using all of the uranium in natural uranium is enormous and may well make the difference between an ample supply of nuclear fuel for many years to come and a rather scanty one.

### First AEC reactor program

When the Atomic Energy Commission took over the plant and equipment of the Manhattan District in January 1947, the problems that I have been reviewing were already clear. Although the Commission's first responsibility was to prosecute the atomic weapons program with vigor, it soon turned to the possibility of atomic power, both for special military purposes and for ultimate peacetime uses. Essentially, the program consisted of a plan to build four major reactors. Let me describe three of these that have been finished at our Idaho test site and why they were built.

The first of them was the so-called materials testing reactor, MTR. It was aimed primarily at getting information on the effects of radiation on uranium fuel elements or other materials that might be used as tubes for cooling water, or as coolants, or containers for uranium fuel elements. The object of this reactor then was to provide very high-intensity radiation in a machine so designed that many experimental samples could be placed in it. It has now been running for about two years, and it has proved exceedingly useful.

The second reactor built in Idaho was the so-called experimental breeder reactor, EBR. As the name implies, it was specifically aimed at demonstrating whether or not breeding was possible. It has demonstrated that breeding is possible and has had a number of other incidental interesting results.

The third reactor was a special-purpose one aimed at providing power for a submarine. You have heard a great deal about that one and about the submarine in which a similar reactor is now being installed.

In all three of these reactors, the neutron economy problem was solved by using uranium from which much of the uranium 238 isotope had been extracted. Whether or not, in the long run, this is the kind of reactor we will build for power purposes will be largely a question of economics.

A more modest undertaking initiated later is the homogeneous reactors experiment at Oak Ridge. From the atomic point of view, the homogeneous reactor is misnamed. One can think of it as a lattice in which the spacing is very small and the size of the fuel elements is of atomic dimension. The fuel in the homogeneous reactor is uranium 235 in a solution of uranyl sulphate in ordinary water. The water serves as the moderator, and the uranyl sulphate molecules serve as the fuel elements in which the chain reaction is set up.

The immediate and obvious advantage of the homogeneous reactor is that fuel fabrication and processing is enormously simplified. The solution is pumped continuously through the reactor chamber and then cooled in outside heat exchangers, and some of it can be continually led off for purification and then reintroduced into the circulating stream of combined fuel and moderator. One of the interesting features of the homogeneous reactor is that it turns out to be self-regulating. As its temperature rises, its reactivity decreases and therefore it controls itself.

One of the most interesting experiments that has been done was carried out last summer at the Idaho Test Site by Dr. W. H. Zinn, director of our Argonne Laboratory, and his associates. We had long worried about what would happen to a water-cooled reactor if the flow of water should be cut off. We were afraid if the water supply was cut off or if the temperature of the reactor rose too rapidly, boiling would occur and that this might have disastrous results. Dr. Zinn decided to make a direct approach to this problem and built a small reactor with the deliberate intention of producing boiling. When it was set up at the Idaho testing station, it had an arrangement in it which suddenly ejected the control rods so that the power generated by the chain reaction went up in a fraction of a second from a few watts to many thousands of watts. This had the expected effect on the water. It boiled. It boiled so violently in fact that it was ejected from the reactor in a small geyser. Repeated trials showed that in every case the boiling reduced the power of the reactor so rapidly that no serious damage was done.

### Results of past five years and present status

Let me summarize some of the major results that we have obtained in the past five years. So far as neutron economy is concerned, we have learned a great deal about the probabilities of various nuclear events, including the relationship between the probability of fission and the energy of the neutrons. We have found that we can use a number of different substances as moderators—specifically beryllium, light water, and heavy water in addition to the familiar graphite.

As to the effects of radiation, the MTR has been of the greatest value, as one might expect, since it was designed for that purpose. But we also have the benefit of studying the fuel elements that have been in the EBR and in the submarine thermal reactor. These too have been valuable. We have made a great variety of alloys and have tested various fuel elements. In particular, the submarine thermal reactor has shown that fuel elements sheathed in zirconium will resist corrosion and radiation effects over considerable lengths of time and represent a great improvement over the aluminum-sheathed fuel elements in the Hanford reactors. Radiation effects have also been studied in a variety of coolants including sodium and heavy water.

In the matter of heat transfer, we have found we can remove the heat from a reactor by circulating molten sodium-potassium alloy through it. This is the system of heat removal used in the EBR. We have also done a great deal of work on pure sodium as a possible coolant and are using it in the second type of submarine reactor now under construction. We have also found that we can use a cooling system of pressurized water. This is the system used in the submarine thermal reactor. We have run reactors at much higher temperatures than we were ever able to run them at Hanford, and therefore we have moved in the direction of efficient use of the energy from nuclear fission.

As to control and instrumentation, the most striking results have been that certain types of reactors are in fact self-regulating as a result of boiling or near boiling as the temperature rises.

The only other result I will mention is the use of hafnium as a material for control rods. Hafnium is present as an impurity in zirconium and has to be removed before zirconium cladding can be used for fuel elements because it absorbs neutrons. For the same reason it is very useful as a control material.

In the matter of chemical processing, perhaps it is fair to say that most of the work has been accomplished in the laboratory, although we have had experience with actual processing of the various types of fuel elements in the new reactors, none of which is exactly like those at Hanford. We have also proved that the homogeneous reactor will work, at least on a small scale, and we therefore know that that is one direction in which to hope for improvement.

In the matter of costs, we still have much work to do. None of the reactors that we have actually put up is cheap, either to build or to operate. The submarine thermal reactor probably costs somewhere around $1,500 or $2,000 per kilowatt to build, which is to be compared with the cost of a modern steam plant somewhere around $180 per kilowatt. But the submarine thermal reactor does prove one overall major result—namely, that it is possible to build a reactor for the production of power that will run for at least reasonably long periods continuously and efficiently.

### Questions still to be answered

The fundamental question still to be answered is whether a power-producing uranium reactor can be built which will compete with other sources of energy. The answer to that question will be found in the choice of some one of the kinds of reactors we have already built or thought about. None of them has yet been proved to be the ideal or even the best choice. The homogeneous reactor, for example, does simplify chemical processing, but it requires enriched fuel, and it is not yet certain that the corrosion problems can be solved. The breeder has not yet been proved on any large scale, so that we do not know at all how expensive that may be. The submarine thermal reactor uses such expensive materials for cladding the fuel elements that it is almost certainly not competitive, even though we may be able to produce zirconium at lower and lower costs. It also uses enriched material.

### Five-year program proposed

In the last few months we have been reviewing the results that we have obtained up to the present time and planning what would be best to do over the next few years in order to arrive at an economical solution of the problem of nuclear power. We have decided that there are six programs that we should pursue. One of these is the general program that we must obviously continue, the program of research on fundamental properties of materials, on nuclear reactions, on components that might go into the reactors of the future, and on chemical processes. This work will be continued principally in our Argonne and Oak Ridge laboratories. In addition to this general research and development work, we wish to build five reactors of varying size and cost. The Commission has recently submitted to the Joint Committee on Atomic Energy a special report on the reactor program prepared at the request of the Committee.

1. **Pressurized water reactor.** The first of these reactors in our new program has already been publicly announced. It is the so-called pressurized water reactor (PWR) which is designed to generate at least 60,000 kw of electric power. It will use slightly enriched uranium as fuel,

ordinary water as a moderator and coolant. The reactor will be operated under reasonably high pressure and temperature, not nearly so high as are used in modern steam plants, but as high as we feel safe in terms of our present knowledge. Specifically, the water in the reactor will be under 2,000 psi and at a temperature between 500 and 600 deg F. Steam will be delivered to the turbine at about 600 psi. The temperature is limited by the corrosion of the fuel elements and piping and container, and the pressure is limited by the strength and size of the vessel in which the reactor must be contained.

One of the difficult problems in this reactor will be that of getting control mechanisms to operate in a high-pressure vessel. Principally we hope to learn from this reactor how such a plant may stand up under ordinary operating conditions of a central-station electric power plant and how much it costs to build and operate it. We have no expectation that this reactor will produce power as cheaply as a modern coal-burning plant, but we hope to learn how costs can be cut in later plants. [See page 87.]

**2. Breeder reactor.** The second new reactor we wish to build is a breeder of intermediate size. It will not be of direct interest from the point of view of economic power, but it will be much larger and much more nearly a power producing, continuously operating reactor than the small experiment we have been running out in Idaho. The scale-up planned is from 1,400 to 62,500 kw of heat, and from 170 to 15,000 kw of electric power. Temperatures and steam pressure will be increased to values appropriate to a full-scale power breeder reactor. Auxiliaries such as pumps, heat exchangers, and valves, will be of sizes suitable to a full-scale reactor.

**3. Boiling-water reactor.** Our third step is based on the boiling-water experiment already described. It will be an attempt on an intermediate scale to use boiling of the water as a method of heat extraction. We hope in this way to get a very cheap method of getting the heat out of the reactor and possibly of eliminating one step between the coolant in the reactor and the turbines which turn the generator. It is planned to feed the steam generated in the reactor directly to the turbines. Present plans call for 20,000 kw of heat and 5,000 kw of electric power.

**4. Homogeneous reactor.** The fourth reactor which we intend to build is a larger version of the homogeneous reactor. Again it will be a step in the direction of a practical power-producing unit and should give us information about corrosion, chemical processing, and operating conditions that cannot be obtained with the small machine now in use at Oak Ridge. Present specifications call for only 3,000 kw of heat in this reactor experiment compared to 1,000 in the present experiment. The next step, already planned, calls for 65,000 kw of heat in a homogeneous reactor which will breed uranium 233 in a blanket of thorium surrounding the chain-reacting core.

**5. Sodium-potassium graphite reactor.** The fifth reactor experiment we plan to build is a little different from any that I have described. The breeder reactor uses liquid sodium-potassium alloy as a coolant. The Hanford reactors use graphite as a moderator. We hope to be able to combine these two materials, getting the advantage of high temperature without high pressure from the sodium coolant. To test this combination, we will build a reactor generating about 20,000 kw of heat but without any electric generating plant attached.

In addition to these five new proposals, we shall continue several other programs already under way. These include the so-called intermediate submarine reactor now under construction at West Milton, N.Y., near Schenectady, and the development of a reactor to propel aircraft. Though the aims of both of these projects are special, they will undoubtedly contribute to the general technology.

### Costs still high

It is evident that we can build power plants which will convert the energy released in nuclear fission into electrical energy to be fed into transmission lines. The question that has not been answered, and may not be conclusively answered even by the program here outlined, is whether this power can be produced cheaply enough to be of general use. The Atomic Energy Commission believes that it can be done, and this is the opinion also of the several private industrial groups who have been studying the problem for several years at the invitation of the Commission. At present, the power delivered by the submarine reactor at our Idaho plant costs about ten times as much as it would if we bought it from the Idaho Power Company. From this figure you can see that it will require all the ingenuity of our staff, our contractors, and private industry working together to get costs down, but it is reasonable to assume that eventually this will be done.

### Industrial participation

These private industrial groups are interested in more than just cost studies. They have assigned able members of their staffs to design studies of nuclear power plants and in some cases are doing considerable amounts of research at their own expense. But it is a mistake to think that private industry can or will pick up the burden of development of nuclear power plants in the present state of the art. It is a field in which knowledge and competence are still largely confined to Government laboratories and in which the financial risks are still too great for private industry to carry alone.

The Commission hopes for greater and greater participation by industry both technically and financially and for a gradual transfer of the nuclear power part of the Commission's responsibilities to private enterprise. To discuss the many problems of such a transfer would need another speech. Personally, I feel they are just about as difficult as the technical problems of getting cheap nuclear power. Time, money, and thought will be needed for both sets of problems. I believe they can be solved.

### Conclusion

To establish a nuclear power industry in this country will be a great achievement. If power becomes cheaper and more plentiful, our material standard of living will be raised. In other countries the effect may be even greater. By the accident of history the first use of this great new discovery has been in the development of weapons of war, weapons of appalling magnitude. The nations of the world have today the means to destroy each other. They also have, in this same nuclear energy, a new resource which could be used to lift the heavy burdens of hunger and poverty that keep masses of men in bondage to ignorance and fear. Toward this peaceful development of nuclear power we have, all of us, a high obligation to work with all the ingenuity and purpose we possess.

Long a dream of engineers, linking of Upper Peninsula with rest of Michigan will be accomplished by $99,800,000 suspension bridge. Main suspension span has length of 3,800 ft.

**C. H. GRONQUIST, M. ASCE**

**Associate Engineer, D. B. Steinman, Consulting Engineer, New York, N. Y.**

# Fifty-year dream nears reality

## Construction of Mackinac Straits Bridge begins in 1954

There are some engineering projects which appeal with peculiar force to the imagination of all men and to the mind and heart of the engineer in particular. The bridging of the Straits of Mackinac is such a project. It has been a challenge to the engineer and to the people of Michigan for the past half-century. The physical difficulties posed by unusual ice conditions, a short construction season, the length of the water crossing, and the depth of the water have been great. Actually, however, no records will be exceeded in length of crossing, span length, or pier depth in the building of the Mackinac Straits Bridge. This project has finally developed to the point where it is ready to proceed to fruition because the needs of the state demand it, and because traffic requires it. The bridge engineers of America have shown by the construction of similar components at other locations that the job can be done and that it can be done economically.

Because of its unusual brecciated formation, the geology of the area has, for over a hundred years, attracted the attention of geologists and aroused the interest of engineers. A geological report by Professors Charles P. Berkey, Hon. M. ASCE, and Sidney Paige, M. ASCE, of Columbia University, submitted to the Mackinac Bridge Authority, concluded that "the Mackinac breccia and the elements composing it, which is the principal formation involved in this problem, has the strength required to support the proposed bridge piers with an ample margin of safety."

Compression tests on samples of the material and in-place loading tests made by W. W. McLaughlin, Director of Testing and Research of the State Highway Department, and Prof. W. S. Housel, M. ASCE, of the University of Michigan, led them to conclude, in the report dated March 1951, that "the most positive data from the loading tests indicates a yield value of approximately 60 tons per sq ft, or about four times the suggested design capacity for dead load and normal live load."

Borings and probings were made at the site in 1939, and additional borings and probings will be made at the exact pier locations.

A second geological feature of importance to the construction of the bridge is the hidden rock gorge underlying the channel between Mackinaw City and St. Ignace. East of the proposed crossing the gorge veers north, makes a loop around Mackinac Island and enters Lake Huron. This gorge was eroded through the breccia at a time when the level of Lake Huron was much lower than at present. The 1939 subaqueous explorations extended to depths that were necessary to locate the rock bed of the gorge.

The most suitable location of the bridge, as determined by a previous study, is directly north from Mackinaw City to St. Ignace. In 1940 a mole or fill some 3,500 ft in length was constructed into the Straits from St. Ignace on this line. This location best fits the existing state highway system, and the location was confirmed and retained for the final design of the crossing. Construction of the bridge on this location will be most economical because the length of crossing is a minimum and full use is made of the existing mole.

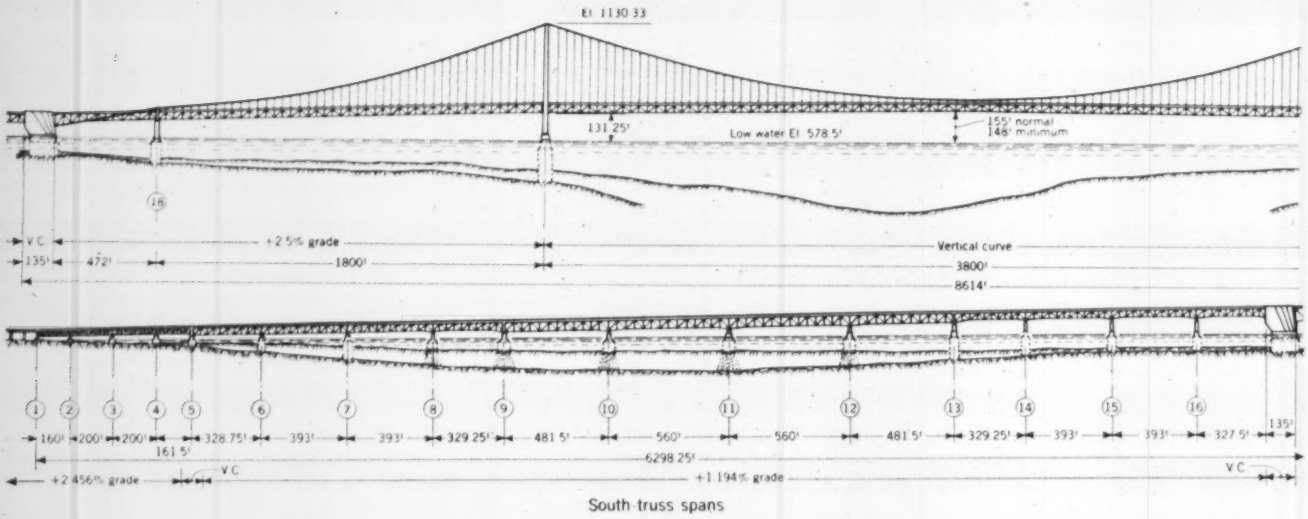
### Four lanes to expedite traffic

On a bridge of this length (26,000 ft) there will undoubtedly be breakdowns and car stoppages for various reasons. With fewer than two lanes for traffic in each direction, such a stoppage would result in serious interference with traffic. A four-lane structure was therefore adopted to insure a smooth flow of traffic at all times.

A center mall or traffic barrier of the low type, 2 ft wide, was also adopted. Vehicles can stay closer to a low, well-marked barrier than to a high mall, thus justifying a somewhat narrower traffic lane next to the mall. These considerations, as well as reasons of economy, have led to an overall width of roadway between curbs of 48 ft, of which 2 ft will be occupied by the center mall, 12 ft by each outer lane, and 11 ft by each inner lane.

No provision is considered necessary on this four-mile-long bridge for regular pedestrian traffic. However, footwalks on each side are essential for maintenance and operating personnel and also in emergency cases for occupants of vehicles. A width of 3 ft between curb and railing has been adopted for each of the two emergency footwalks. The overall width of the floor between railings is 54 ft.

A span of 3,800 ft has been fixed to cross the deep gorge under the main channel, with main piers founded on rock at approximately 195 ft below lake level. For any shorter span the

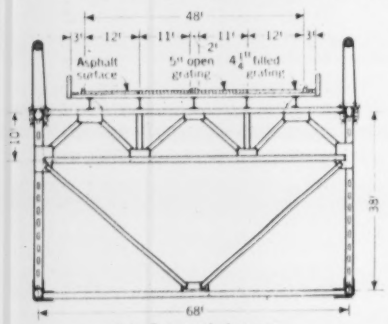



South truss spans

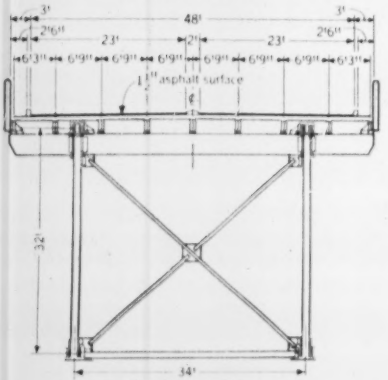
**TABLE I. Span lengths of Mackinac Straits Bridge**

| | |
|---|---|
| Main crossing: | |
| Suspension bridge, including anchorages | 8,614 ft |
| South truss spans | 5,694 ft |
| North truss spans | 3,610 ft |
| | 17,918 ft |
| Approaches: | |
| Mole section | 3,507 ft |
| Mackinaw City approach | 486 ft |
| St. Ignace approach | 4,284 ft |
| | 8,277 ft |
| Total length of bridge and approaches | 26,195 ft |

FIG. 2. Section through suspended spans (a) and that through truss spans (b) show typical framing details. Open framing of suspended spans adds to aerodynamic stability of structure. Lateral bracing of upper and lower chord greatly increases rigidity.




(a) Suspended span




(b) Truss span

piers become excessively deep and expensive. The only feasible type of structure for a span of such length is a suspension bridge. For economy, side spans of 1,800 ft with unloaded backstays of 472 ft are used. This permits the anchorages for the cables to be placed where suitable rock foundations are found at the moderate depths of 86 ft and 70 ft below lake level for the south and north anchorages respectively (Fig. 1).

A number of alternate layouts made for the remainder of the crossing over the waterway between the south shore and the end of the mole at the north shore have led to a series of continuous truss spans on concrete piers as the best solution. Twenty spans over the deep portions of the waterway range in length from 560 to 330 ft. Four spans near each shore have lengths of 160 to 200 ft. These span lengths were economically determined by the deep and massive piers required to withstand the ice pressures.

For the north approach, full advantage is taken of the existing mole by constructing a viaduct and a roadway on a fill placed on top of the existing causeway. The maximum height of new fill will be 12 ft.

From the end of the mole and from the Mackinaw City shore, the bridge roadway ascends by easy grades not exceeding 2.5 percent to the towers of the main bridge. Over the center span the roadway is cambered on a parabolic curve. These grades allow a minimum clear height above mean lake level of 135 ft for a width of 3,000 ft of the main channel. The minimum clear height at the center of the span is 148 ft. The total length of the proposed bridge and approaches is about five miles, made up as shown in Table I.

### Superstructure of suspension bridge

With a central span of 3,800 ft, the suspension bridge across the main channel will be second in length to the Golden Gate Bridge in San Francisco, which has a span of 4,200 ft.

In its major carrying members, that is the cables, towers, and anchorages, the design of the Mackinac Straits Bridge follows closely the practice established by other modern long-span suspension bridges.

Two cables, each of 24.25-in. diameter, carry the four-lane structure. Each cable is composed of 37 strands of 348 wires, of 0.196-in. diameter, all wires galvanized, making a total of 12,876 wires per cable. The cable sag of 350 ft, or about one-eleventh of the center span, is somewhat less than in some other suspension bridges, but is conducive to gracefulness and gives greater stiffness to the structure. The weight of cable wire and fittings is over 25,000,000 lb.

The steel towers are the conventional flexible type with fixed bases. The tower shafts are of cellular construction with access for the cleaning and painting of all interior surfaces. They extend 548 ft above lake level. A service elevator is provided in one shaft of each tower for convenient access to all parts. The two shafts of each tower are connected by horizontal struts, which are of open trussed construction. The shafts and struts form integral parts of a rigid frame designed to transmit the lateral wind forces to the pier. The cable bents supporting the side-span trusses and the main cables are also of steel construction supported on concrete piers.

The suspenders which transmit the load of the suspended structure to the cables are standard wire ropes with independent wire-rope centers.

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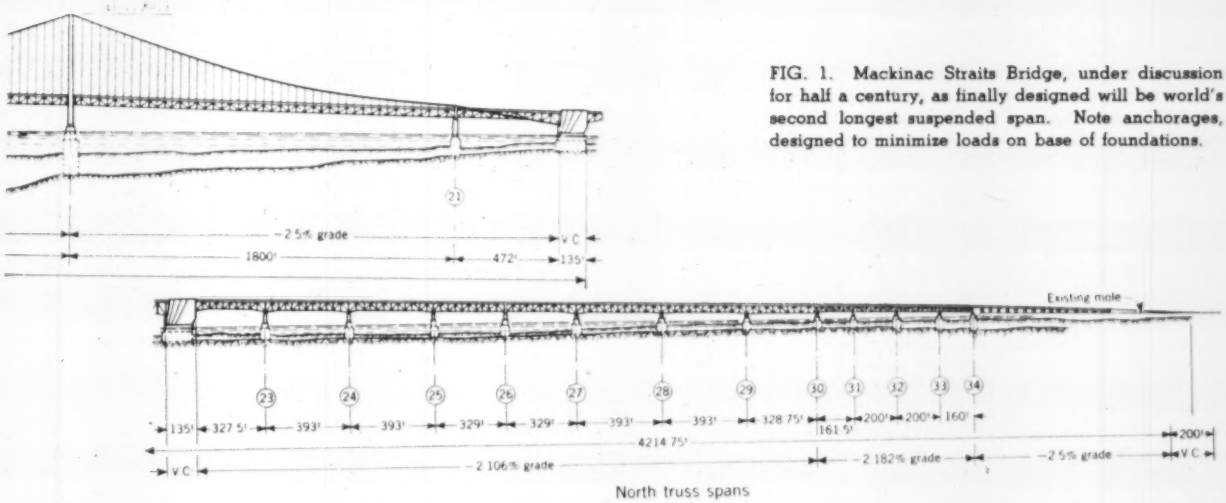


FIG. 1. Mackinac Straits Bridge, under discussion for half a century, as finally designed will be world's second longest suspended span. Note anchorages, designed to minimize loads on base of foundations.

Spaced at 39-ft centers, each suspender is composed of two parts of a $2^1/_4$-in. rope looped over and resting on a steel cable band clamped to the cable. The socketed ends of the $2^1/_4$-in. ropes are attached to the top chord of the stiffening trusses.

The suspended structure includes two stiffening trusses, 68 ft center to center, one in the plane of each main cable. They transmit the floor loads to the suspenders and stiffen the structure against distortions due to live load and against oscillations under the action of dynamic loads and wind forces.

The floor of the suspended spans is designed to be light in weight for maximum economy in the long spans and to have highly favorable aerodynamic characteristics. The inner 11-ft lanes and the 2-ft center mall will be constructed of 5-in. open grating, weighing about 20 psf. The outer 12-ft lanes will consist of $4^1/_4$-in. steel grating filled with lightweight concrete topped by a bituminous wearing surface, and weighing 65 psf. The major part of the traffic will use the outer solid lanes, while the inner open-grating lanes will be used mainly during peak-load hours. The emergency walkways will also be constructed of open grating. The grating for the roadways, and that for the walkways also, will be supported on 12-in. cross beams which in turn will rest on five rows of longitudinal stringers, continuous over two 39-ft panel lengths (Fig. 2*a*).

The specifications for materials, loads, and permissible stresses which have been used as a basis for the design of the Mackinac Straits Bridge follow general practice for modern structures of this type and magnitude. For the floor structure throughout, and for the shorter main girders and trusses, the current specifications of the American Association of State Highway Officials have been followed, with the basic standard loading of H20-S16-44 as generally applied to the design of bridges on major highways.

The latter specifications are intended to apply to bridges of ordinary type and moderate spans. For the design of the stiffening trusses, cables, towers, and anchorages of the suspension span and for the long trusses of the other spans of the main crossing, special load and stress specifications were adopted in accordance with best modern practice for structures of such magnitude. For the suspension spans a basic live load of 2,000 lb per lin ft of bridge has been adopted in accordance with the standard specifications.

On account of the possibility of high winds of considerable extent and the exposed location of the bridge, a static wind pressure of 50 psf of exposed area was assumed over the entire structure. This corresponds to a wind velocity of about 120 mph as compared with the maximum recorded velocity of 78 mph observed in the vicinity.

The cables will be spun after the towers, cable bents, and anchor chains have been erected. The suspended structure will then be erected using light travelers which will run on the cables. Completely braced units of two panel lengths, or about 80 ft, consisting of the two stiffening truss sections and two trussed floor-beams with sway bracing, will be raised from barges.

## Aerodynamic design

The question of adequate resistance against aerodynamic action has received intensive attention from the engineering profession, both in this country and in England, since the failure of the original Tacoma Narrows Bridge in 1940. In the design of the Mackinac Straits Bridge, aerodynamic stability has been a prime consideration. This is reflected in several features of the design:

1. The stiffening trusses have been given a depth of 38 ft, center to center of chords, or 1/100 the length of the span. This ratio is the same as that adopted for the 3,600-ft span of the Severn River Bridge in England and compares favorably with the 1:168 of the 4,200-ft span of the Golden Gate Bridge and the 1:107.5 for the 2,150-ft span of the recently constructed Delaware Memorial Bridge at Wilmington.

2. The transverse floor beams, which carry the longitudinal stringers and floor and transmit their load to the stiffening trusses, are designed as open trusses instead of the usual solid-web girders, thus minimizing wind pressure against them.

3. A double system of horizontal trusses, one in the plane of the top chords and one in the plane of the bottom chords of the stiffening trusses, is provided. This substantially increases the torsional rigidity of the suspended structure as compared with that provided by a single system which, until recently, has been conventional practice for large suspension bridges (Fig. 2*a*).

4. The relatively wide spacing of the cables and stiffening trusses, 68 ft center to center, in comparison with the floor structure width of 48 ft between curbs, gives wide open spaces between the trusses and the roadway. These openings, together with the center 24 ft of the open-grating floor and the open-truss type of floor beams, all contribute to yield

favorable aerodynamic characteristics representing assured aerodynamic stability.

The tests made in connection with the redesign of the Tacoma Narrows Bridge, the modifications of the Golden Gate Bridge, and those for the design of the Severn River Bridge, clearly demonstrate the beneficial effects of such openings in the floor structure as well as the advantage of the double lateral system.

Under the direction of the engineers, several series of wind tunnel tests have been made on a section model of the suspended structure by Prof. F. J. Maher at Virginia Polytechnic Institute. The model represented a 120-ft length of bridge to a scale of $\frac{1}{8}$-in. to the foot.

At a wind velocity of 100 mph and for zero angle of attack, the wind force or drag for the Mackinac Bridge, according to the wind tunnel tests, is 670 lb per lin ft of bridge, and the upward vertical lift is 50 lb per lin ft of bridge. The bridge is designed for a horizontal wind load of 50 psf, which is equal to 960 lb per lin ft of bridge, corresponding to a wind velocity of 120 mph.

Stability response graphs showing the variation of damping with wind velocity have been computed from the static lift and torque graphs. These curves show a high degree of positive stability for all wind velocities, and they are confirmed by the results of tests on oscillating section models of the proposed bridge.

### Superstructure of truss spans

Between the south anchorage of the suspension bridge and Mackinaw City there is the secondary gorge with a maximum depth to rock of 174 ft below lake level. This gorge is to be crossed with continuous truss spans ranging up to 560 ft in length. These span lengths are dictated by the cost of the pier foundations near the center of the gorge. The spans are balanced by similar though shorter spans north of the suspension bridge. Depth to rock in this part of the crossing nowhere exceeds 60 ft below lake level.

It has been determined that the most economical floor for the truss spans is a 6-in. reinforced concrete slab topped by a bituminous wearing surface. Stringers are spaced 6 ft on centers and are continuous over two to four spans for a maximum length of 160 ft between joints (Fig. 2*b*).

To provide the most economical foundations and to effect maximum economy in the floor beams, the trusses are spaced 34 ft apart, and the floor beams are cantilevered.

The 470-ft truss spans from the anchorages to the cable bents, at the ends of the suspension-span stiffening trusses, also have trusses spaced 34 ft apart, giving ample clearance for the cable backstays from the cable bents to the anchorages. These trusses are fixed to the anchorages for maximum rigidity and economy.

The span grouping of 327-, 393-, 393-, 327 ft, with a total length of 1,440 ft, is used twice in both approaches. The 160-, 200-, 200-, 160-ft grouping, with a total length of 720 ft, is used at the shore end of each approach. Thus economy is secured by duplication of design, detail, and fabrication. A 480-, 560-, 560-, 480-ft grouping, with a total length of 2,080 ft, is used only in the south approach over the secondary gorge.

The continuous truss spans will be erected by floating them in and cantilevering them on falsework bents. In the portion of the 470-ft spans where the water is deepest, the spans are to be floated in. The weight of structural steel in the entire bridge is over 50,000 tons.

### Suspension bridge foundations

After careful consideration of the data concerning ice conditions in the Straits and further investigation of the latest information on ice pressure on engineering structures, the very severe assumption of an ice pressure of 115,000 lb (65,000 lb for circular surfaces) per lin ft of pier width at the water line has been adopted. This assumed loading is considerably greater than that generally assumed for engineering structures under comparable climatic conditions, and is five times as great as the maximum pressure ever recorded, according to recent engineering literature.

Foundation construction will be by the open-dredged caisson method for three of the major piers, and by the cofferdam method for the remainder of the piers.

The concrete piers for the towers of the suspension span are composed of two cylindrical concrete pedestals supported on the caisson concrete base at an elevation of 8 ft below lake level and extending to a height of 25 ft above lake level. The caissons will be founded at a depth of 195 ft below lake level, and will have a diameter of 116 ft. The concrete volume in each pier is 70,000 cu yd, which corresponds to a weight of 140,000 tons.

All piers will have wrought-iron plates at lake level for protection against wave and ice action, and the shafts will be shaped to break the ice and minimize the ice pressure.

The cable anchorages are massive concrete structures which resist the pull of the cables and transmit this reaction to the underlying rock. The total concrete in each anchorage is approximately 85,000 cu yd, corresponding to a weight of 170,000 tons. Through proper distribution of the mass of concrete, with hollow chambers in the upper section, the resultant of the cable pull and anchorage weight is so located as to minimize the loads on the base of the foundation. The anchorage foundations, which extend to depths of 86 and 70 ft below water, will be constructed in open cofferdams. The pier for the south cable bent at the end of the side span will extend to a depth of 128 ft below water level and will be built as an open caisson. Concrete in the suspension bridge foundations totals 340,000 cu yd.

The truss-span piers consist of circular reinforced concrete shafts, designed to minimize ice forces, which extend to lower blocks, and finally to the circular pier base on rock.

The nine piers (Nos. 6 to 14) in the secondary gorge, where rock dips to a depth of 174 ft, will be supported on steel H-piles, a large proportion of them battered to resist horizontal forces. These piers as well as most of the remaining piers on the north approach will be constructed in open sheet-pile cofferdams to a maximum depth of 82 ft below the water level. The total amount of concrete in all foundations is over 425,000 cu yd.

### Approaches in three sections

The approaches are naturally divided into three sections: the construction over the 3,500-ft rock-filled mole built in 1940, the Mackinaw City approach, and the St. Ignace approach.

1. For the section over the existing mole, the roadway will be carried on a viaduct, and on a fill to be placed on top of the present mole.

2. For the Mackinaw City approach, steel beam spans with concrete paving, resting on concrete piers, will be used. The roadway in this approach will be widened to six lanes, three in each direction. These additional lanes will provide a traffic reservoir so that the capacity of the bridge will not be controlled by the street intersections in Mackinaw City.

3. The St. Ignace approach consists of a four-lane roadway partly on fill, partly in cut, extending from the end of the mole to the bridge toll plaza north of Graham Street. A six-lane road extends north from the toll plaza to a junction with U.S.

Highway No. 2. At this junction (Fig. 3) the approach separates to accommodate the traffic turning westward and that continuing northward towards Sault Ste. Marie.

Tolls are to be collected at the plaza located on the St. Ignace approach. Adjacent to the toll plaza will be an administration building to house operating and maintenance personnel and equipment.

Climatic conditions, and especially the ice, limit the working season for the construction of the piers of the main crossing to the eight months of April through November. Construction of the substructure, and particularly that of the main tower piers, therefore determines the time of completion of the bridge. The construction schedule is given in Table II.

The bridge is expected to be open to traffic by November 1, 1957. Completion of such items as wrapping of the main cables of the suspended spans and final painting may be done in the 1958 season without interfering with the normal flow of traffic.

During 1956 and 1957 separate contracts will be let for the construction of the administration building, toll booths, maintenance buildings, and equipment. Completion date for these structures will be October 1, 1957.

Engineering-wise, the feasibility of this project has been amply demonstrated by the investigations of five groups of engineers in the past 25 years and by the design here described.

A probable annual traffic of 1,927,000 vehicles and a gross annual income of $5,935,000 for 1958, the first full year of operation, were predicted in the December 1953 report of the traffic engineers, Coverdale and Colpitts, who are outstanding in their field. The coverage for a $99,800,000 bond issue, to include all costs of constructing and financing the project, is 1.47 times the principal and interest requirements, and the bond issue can be amortized by the year 1975. Estimated costs are given in Table III. With the two major construction contracts already let, the greater part of the work is under contract.

Construction of the Mackinac Straits Bridge will benefit not only the Upper Peninsula, but the entire State of Michigan, and not only Michigan, but the north-central part of the United States and part of Canada. The time now finally has come to bring this dream of a half-century to reality. The Mackinac Bridge Authority, together with its engineers and financial advisers, have labored hard and long to complete plans and consummate the financing of the project. With the start of construction this May, operation number one of the bridging of the Straits of Mackinac will go into high gear. As indicated in Table II, construction of the major part of the suspension bridge foundations, involving the placing of about 300,000 cu yd of concrete, is planned for this year.

The membership of the Mackinac Bridge Authority is as follows: Prentiss M. Brown, chairman; Mead L. Bricker, William J. Cochrane, Charles T. Fisher, Jr., George A. Osborn, Charles M. Ziegler, and Lawrence A. Rubin, secretary. The Authority has retained D. B. Steinman, M. ASCE, consulting engineer, for the design and supervision of construction of the entire Mackinac Straits Bridge project. Glenn B. Woodruff, M.ASCE, consulting engineer, has been retained by Dr. Steinman as consultant.

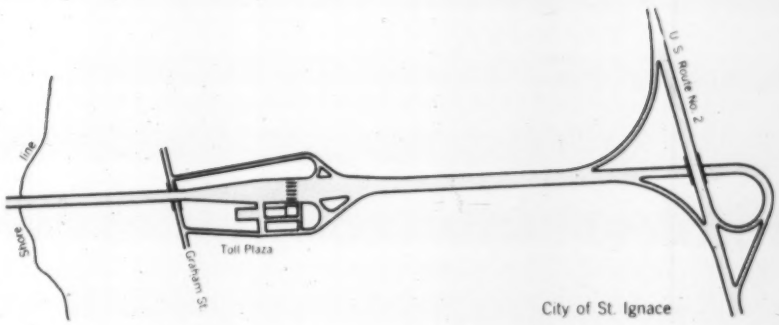


FIG. 3. Toll booths are placed at St. Ignace approach plaza. Although connection to U.S. Route 2 is six-lane road, Mackinac Straits Bridge will carry only four lanes.

**TABLE II. Construction schedule for Mackinac Straits Bridge**

| CONSTRUCTION SEASON | WORK TO BE PERFORMED |
|---|---|
| 1954 | Construction of south truss span piers Nos. 1 through 16 to El. +10 |
| | Construction of anchorage piers Nos. 17 and 22 to El. +10 |
| | Construction of main tower piers Nos. 19 and 20 |
| | Construction of cable bent piers Nos. 18 and 21 to El. +10 |
| 1955 | Completion of all foundations |
| | Erection of truss spans Nos. 1 through 16 |
| | Erection of main towers |
| | Erection of cable bents |
| 1956 | Spinning of cables |
| | Erection of truss spans Nos. 23 through 34 |
| | Construction of Mackinaw City approach |
| 1957 | Construction of mole approach |
| | Completion of anchorages |
| | Completion of cable and suspender erection |
| | Erection of suspended spans |
| | Paving of roadways |
| | Construction of St. Ignace approach |

**TABLE III. Estimated construction costs for Mackinac Straits Bridge**

| | |
|---|---|
| Main bridge, foundations, lump-sum contract with Merritt-Chapman & Scott Corp. | $25,735,600 |
| Main bridge, superstructure, fixed unit price contract with American Bridge Division, United States Steel Corp. | 44,532,900 |
| Concrete deck on approach truss spans and paving on suspended spans | 1,450,000 |
| Approaches (Mackinaw City and St. Ignace, and Mole section) | 2,050,000 |
| Administration building, toll plaza, operating and maintenance equipment, electrical equipment | 800,000 |
| Additional borings, engineering, contingencies | 4,705,750 |
| Total construction cost | $79,274,250 |

*(This article is based on the paper originally presented by Mr. Gronquist before the District 7 Conference held at the Michigan College of Mining and Technology, Houghton, Mich., and later also before the Providence Section of ASCE, Providence, R.I.)*

# Stokes' law confirmed by falling sphere experiment

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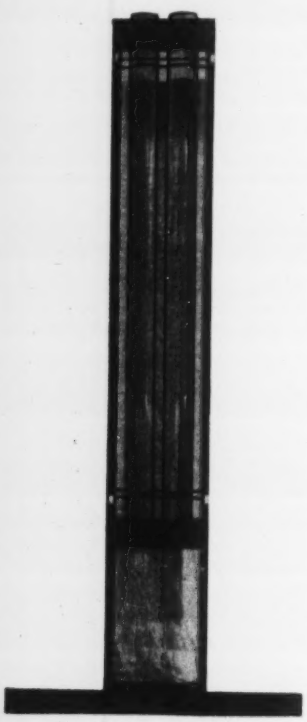
**Sixth article in the series sponsored by the Fluid Dynamics Committee of ASCE's Engineering Mechanics Division**



Apparatus consists of two vertical lucite tubes of standard 52-in. length and 3-in. diameter, containing very viscous and transparent oils and mounted in stable structural frame. Tubes, oils, and frame (exclusive of labor) are estimated to cost around $30.

A self-contained, inexpensive, simple, and portable apparatus for the modern undergraduate fluid mechanics laboratory can be used to confirm Stokes' law for the laminar motion of a fluid about a sphere. Into the twin oil-filled tubes of this apparatus, shown in the accompanying photo, may be dropped spheres of different materials whose terminal velocities can be easily and accurately measured by timing their fall through a measured distance with an ordinary stopwatch.

The drag coefficient, $C_D$, and the Reynolds number, $N_R$, can be computed from the data obtained and the results plotted to confirm Stokes' law, $C_D = 24/N_R$. The writer has used this experiment for about ten years to extend the undergraduate's experience with fluid friction beyond that of established pipe flow. It also affords him some modest experience with flow about immersed objects without the complications, bulk, and expense of wind or water tunnels.

The apparatus may be used in various ways as a suitable undergraduate experiment. Probably the most comprehensive method is to provide thermometers in the oils and plots of viscosities and specific gravities against temperature. A chemical balance is used to weigh the spheres and micrometer calipers to measure their diameters. "End effects" may be easily eliminated by providing suitable distances above and below the reach over which the falling sphere is to be timed. Wall effect and methods of correcting for it may be discussed in detail and various formulas used to correct the raw data. (See, for example, "Influence of Boundary Proximity on the Drag of Spheres" by J. S. McNown, H. M. Lee, M. B. McPherson, and S. M. Engez, Proceedings of the Seventh International Congress for Applied Mechanics, 1948.) Reasonable care in taking the measurements will produce results that will give excellent confirmation of Stokes' law.

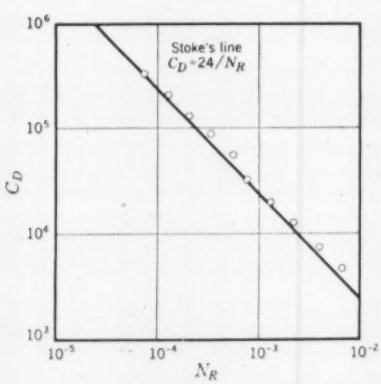



FIG. 1. Experimental points for velocities of larger spheres, when uncorrected for wall effect, show systematic drift away from Stokes line. Drift can be corrected if desired.

A briefer experiment, but one equally suitable for a first laboratory course, is to obtain the viscosities of the oils by dropping very small spheres of such size that wall effect is negligible. Here Stokes' law is assumed to apply and the student has brief acquaintance with the falling-sphere viscosimeter. Specific gravities of spheres and liquids are given so that all measurements are accomplished with micrometer and stopwatch. The viscosities computed above are used in computing the Reynolds numbers for the falls of the larger spheres; if the velocities of the larger spheres are not corrected for wall effect a systematic drift of the experimental points away from the Stokes' line results (Fig. 1). This drift may then be corrected quantitatively or the reason for it merely indicated without adjustment of results.

The apparatus can be put to a third use in more advanced laboratory work with the study of the resistance of non-spherical objects.

If the student is to be impressed with the universality of Stokes' law, it is important that at least two different liquids be used in each apparatus. In order to hold all results within a reasonable range of Reynolds number, lighter spheres are used in the less viscous oils and heavier spheres in the more viscous. "Altavis" oils Nos. 50 and 210 (of Standard Oil Co. of California) are suitably viscous and transparent and have approximate viscosities at room temperature of 0.06 and 0.40 lb sec per sq ft respectively. Steel ball-bearings of $^1/_8$-in. diameter and greater, and chemical glass beads of 4, 5, and 6-mm diameter are suggested for spheres.

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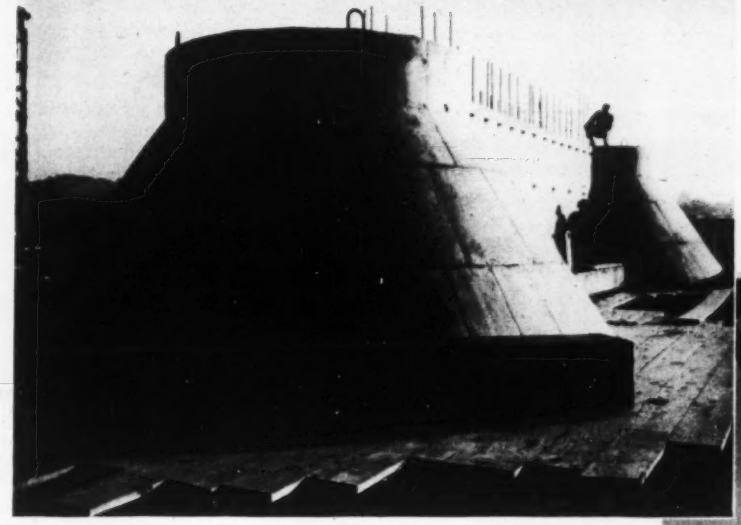
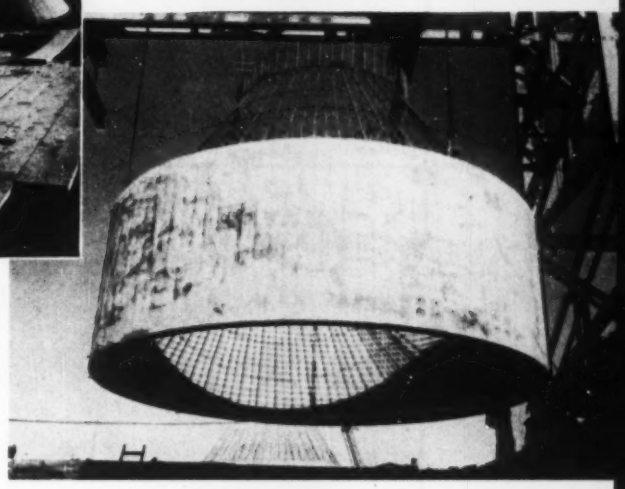




Hollow precast concrete structural units of large size are put together to form under-water portions of piers for Richmond–San Rafael Bridge. After positioning, units are filled with tremie concrete. Precast units are here seen in contractor's yard. Ring at right is placed on pile-supported grid at bay bottom; unit shown above and on cover rests on two of these rings.

# Hollow precast concrete units of great size form bridge substructure

Piers for the Richmond–San Rafael Bridge crossing the north part of San Francisco Bay are beginning to rise above water. These piers (Fig. 1) feature the use of precast concrete structural units, filled with tremie concrete and underwater steel piles of great length.

The Richmond–San Rafael Bridge will cross a 4-mile narrows approximately 10 miles north of the famous San Francisco–Oakland Bay Bridge. It is a $62,000,000 project of the State of California, Department of Public Works, Division of San Francisco Bay Toll Crossings. An article on the studies for the bridge and its overall design, by Norman C. Raab and Ralph A. Tudor, Members ASCE, appeared in CIVIL ENGINEERING for April 1953.

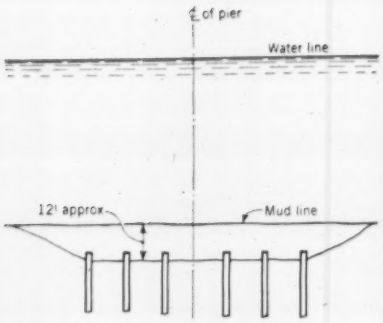
Pier construction began in March 1953 and is scheduled for completion in October 1955, with completion of the cantilever and truss spans and the opening of the bridge to traffic scheduled for October 1956. Sixteen approach piers on the Richmond side are now completed, 5 months ahead of schedule. Four deep-water piers are completed, and several others project above the water. Construction is in various phases of completion on 40 more of the total of 62 deep-water piers.

The route of the bridge parallels that of an existing ferry, and crosses two main ship channels, where the water is some 50 to 60 ft deep. Between the ship channels, just south of the bridge center, a large monolith known as Red Rock juts out of the bay. Tidal currents, which reach 5 to 6 knots in the ship channels, are distorted by Red Rock and at certain stages flow at right angles to the channel. The westerly 2 miles are somewhat shallower, with depths of 30 ft or so, and somewhat slower tidal currents.

The bottom of the bay in this area could be generally described as a thick blanket of very soft mud and sediments overlying rock. The rock surface varies from some 30 ft below sea level to over 300 ft below. Fortunately, in the deepest part there is a thick stratum of dense sand and gravel above the rock.

Because of the foundation conditions, the large number of piers required and the need for early completion (this bridge if financed by revenue bonds), "bell-bottom" type piers were specified. This type of pier was used previously on the Potomac River and Chesapeake Bay bridges, and is constructed under water, using tremie concrete. The piers are supported by long steel H-piles.

The specifications issued for this project wisely limited their requirements to the completed piers and left the method of construction open to



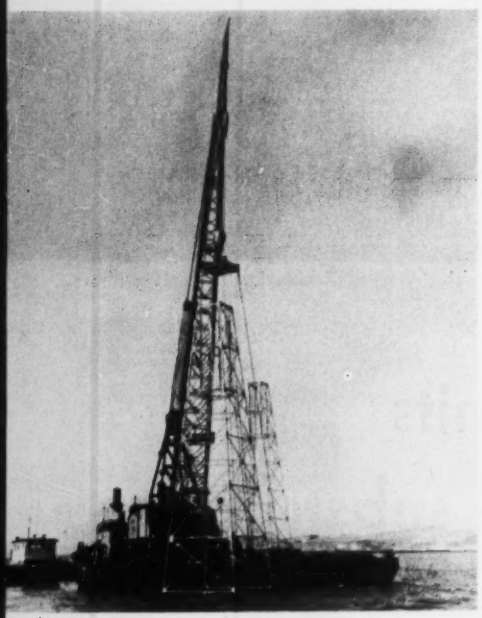

**Step 1:**
Depression about 12 ft deep was dredged in bay mud and in it timber falsework piles were driven under water and cut off to grade, to provide temporary support for precast-concrete grids.

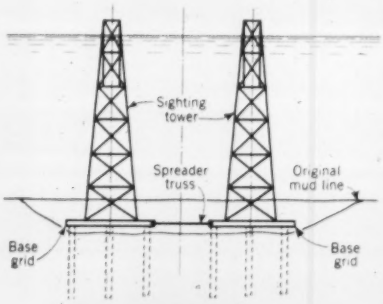
the contractor, subject of course to the approval of the engineers.

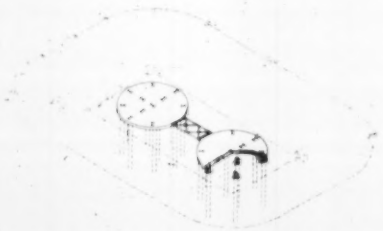
Factors affecting the contractor's decision as to method of construction were:

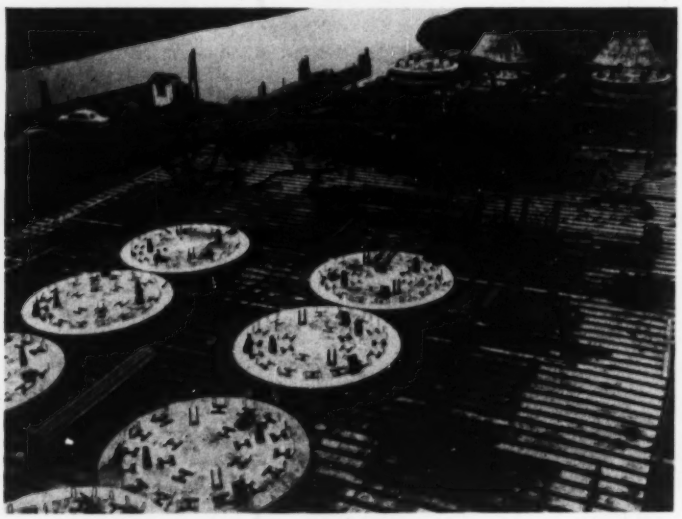
1. Stability against tidal and wave action at every phase of construction.

2. Division of construction operations into many standardized units



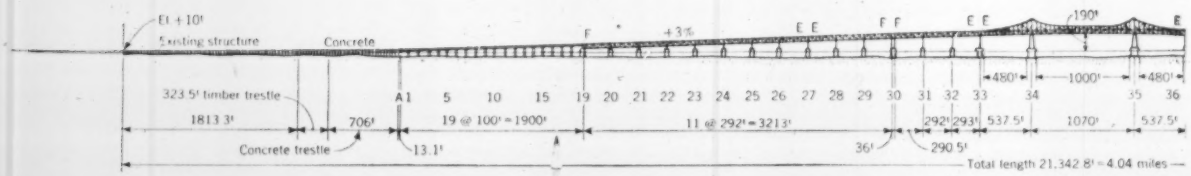




**Step 2:**
Pier base grids and spreader truss between them are placed, using temporary steel sighting towers for accurate positioning as to line and grade. Towers are attached to grids before they are lowered onto wood falsework piles. Grids are shown in manufacturing yard in photo at right. Holes for H-piles were cast into grids.

FIG. 1. Richmond–San Rafael Bridge crosses north end of San Francisco Bay. Piers A through 61 are being constructed by method described in this article. Nine of these (Piers 19, 30, 34, 35, 44, 47, 48, 55, and 61) are four-bell instead of



of reasonable size instead of a few critical very large operations.

3. Use of off-site construction facilities to the maximum extent possible to save time and prevent unnecessary congestion in a crowded shipway.

4. Assurance of high-quality concrete in the extreme outer shell of the piers.

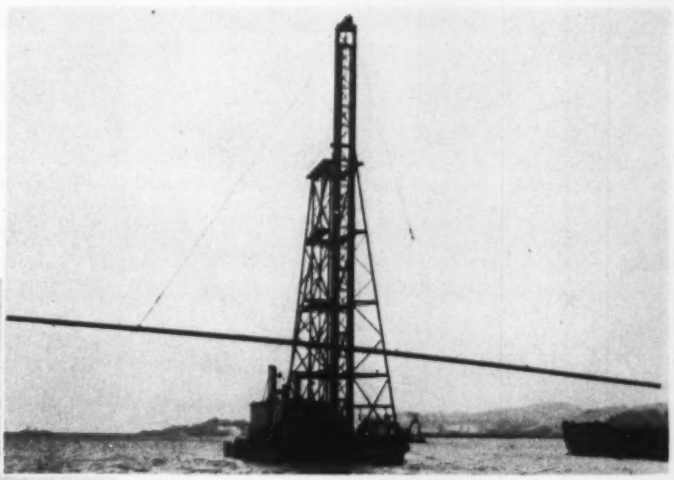
5. Economy.

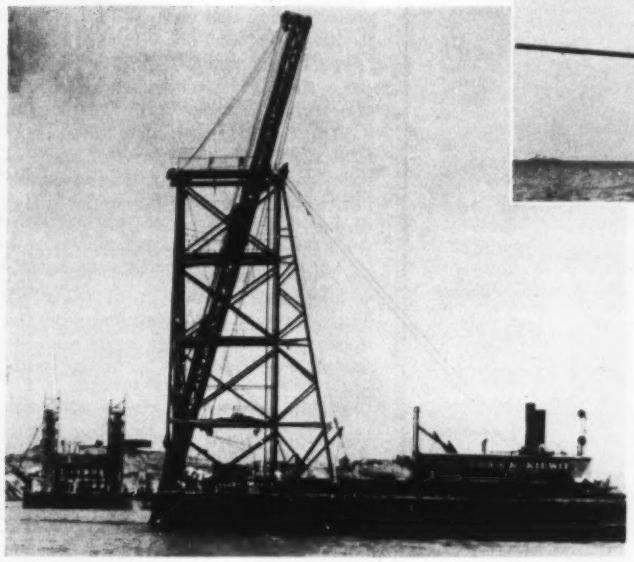
6. Facility and accuracy in placing the reinforcing steel.

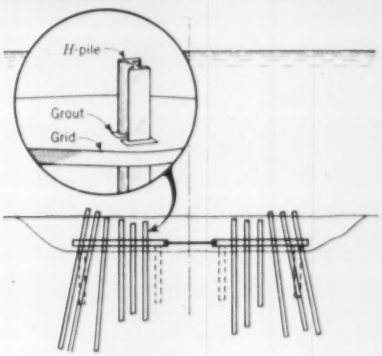
The contractor had recently had experience in the use of precast shells in pier construction for a transmission-line crossing of South San Francisco Bay (as explained in the writer's article in CIVIL ENGINEERING for April 1953) and, several years earlier, on the use of precast units filled and joined with tremie concrete on drydock construction. Extensive tests on the drydock job had shown the high bond value between tremie concrete and precast units, and field evidence had testified to a secondary crystallization between the two.

Further, the contractor owned and operated a large precast concrete manufacturing yard some 14 miles

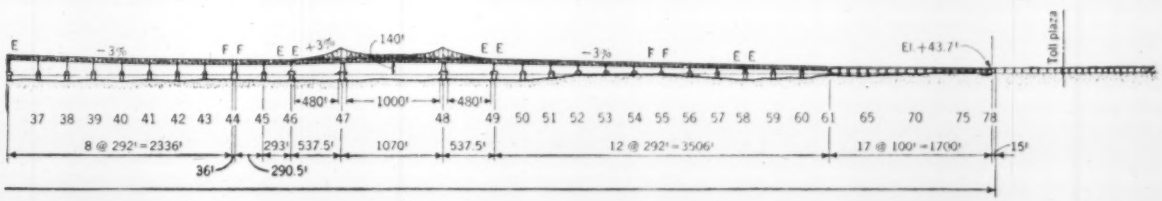
**Step 3:**
Steel H-piles of great length are driven through holes in grids. First, vertical piles are driven and grouted into grid, then battered piles are driven and grouted. In photo at right floating driver "Pacific Titan" picks up 195-ft pile. In photo below "Pacific Giant" drives pile on 3-in-12 batter.








two-bell type, but construction method is similar. Piers 62, 63, 64, 65, 75, 76, 77, and 78 are cofferdam piers. Piers 66–74 inclusive are land piers. All piers (A-78 inclusive) are in one contract.




Elevation

north of the Richmond–San Rafael Bridge, on Petaluma Creek, a navigable arm of San Francisco Bay. This yard, with its excellent source of aggregates and modern mechanized facilities, lent itself to the economical mass production of precast structural units.

Because precast structural units appeared to meet all the requirements most favorably, this scheme of construction was adopted.

After much consultation and constructive revision of plans by the state engineers, the details of the use of precast structural units were worked out. This procedure emphasizes the importance of two points which the writer has set forth in previous articles and which he feels are of utmost importance in the successful use of precast concrete:

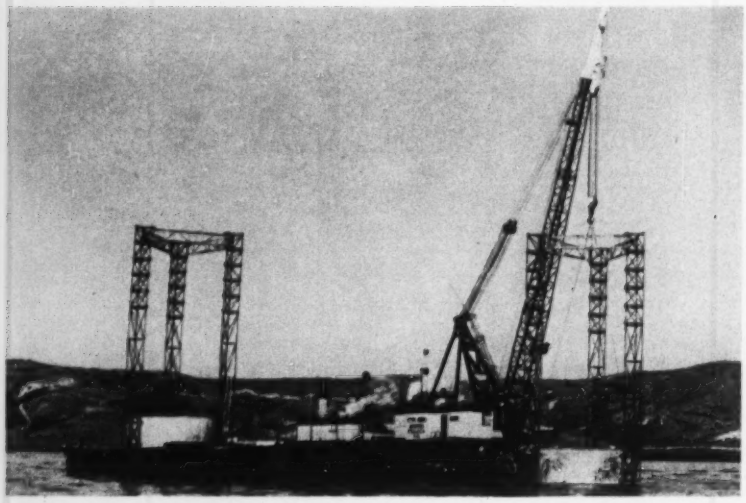
1. Cooperation between the engineer and the contractor in designing and utilizing precast concrete to obtain maximum economy and highest quality.

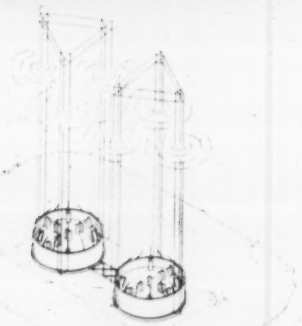
2. Careful attention to connection and joining details.

In general the scheme adopted was the division of each pier into several structural units. Each unit consists of a precast concrete shell 8 in. thick, containing the permanent pier reinforcing steel. After setting, the whole is filled with tremie concrete to tie the units together and to provide the bond for the reinforcing steel splices between the units.

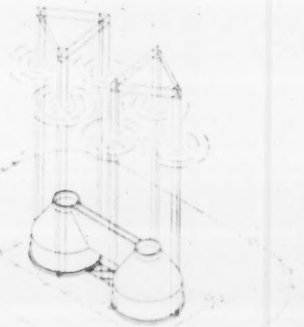
One other major problem that faced the contractor was the twofold requirement that the steel H-piles be entered through a template at the elevation of the pier base, and that the pier base be rigidly supported during initial concreting operations. After extensive tests had demontrated that high bond could be obtained under field conditions between tremie grout and steel piles, and between tremie grout and precast concrete, the pier base itself was designed as a precast concrete grid. This grid, 1 ft thick, has H-slots in it for the vertical and batter piles. After the pier base grid has been set accurately to position and grade on under-water timber piles (Steps 1 and 2), steel H-piles are set and driven through their individual slots; then each slot is filled with tremie grout (Step 3). Thus, the pier base itself supports the upper precast concrete units and the tremie concrete fill as it is being placed.

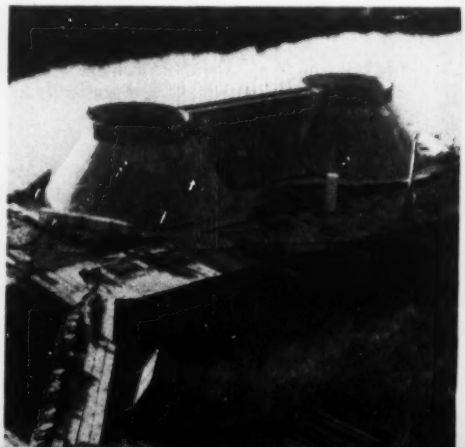
The several steps of pier construction are shown by the accompanying diagrams and photographs, which illustrate how the precast concrete units are being used.





**Step 4:**
Two precast-concrete bottom shells weighing up to 80 tons each are set by floating derrick. Temporary structural steel supports, bolted to shells before sinking, hold tremie pipes and upper precast units. In each shell, 5-ft lift of tremie concrete is poured.





**Step 5:**
Precast concrete cone units weigh up to 130 tons. One unit is seen at casting yard in photo at right. In cover photo it is being placed on bottom shells by 150-ton floating shear-leg "Pacific Atlas."

Each pier is supported by long steel H-piles (see Step 3), some vertical and some on 2-in-12 and 3-in-12 batters, all driven to 100-ton bearing in rock or hard strata. The longest piles driven so far have been 194 ft but it is anticipated that some piles may run up to a length of 200 ft or over. Altogether, some 5,000 piles are required.

Two very large floating piledrivers were fitted out with 120-ft leads, capable of being moved back to the 2-in-12 or 3-in-12 batters as required. In these leads rides a 120-ft set of telescoping leads, which in turn carry a McKiernan-Terry S-10 single-acting steam pile hammer, delivering 32,500 ft-lb of energy per blow.

Since the webs of all the piles in a pier must be oriented along radial lines from the pier center, a standard ship gyroscope has been mounted on each driver. Piles are guided through the H-slot in the precast concrete base grids by a diver.

Pile-driving production has been excellent so far considering the tidal currents, extreme length of piles, batter, orientation, necessity for entering piles through holes in a grid 30 to 60 ft below water, and the hard driving.

Some 60,000 cu yd of tremie and other field-placed concrete must be produced and poured at the 62 pier sites in the bay. For this work, the contractor modified an existing floating concrete plant to raise its rate of production to 120 cu yd per hour. Tremie pours range up to 7,500 cu yd each.

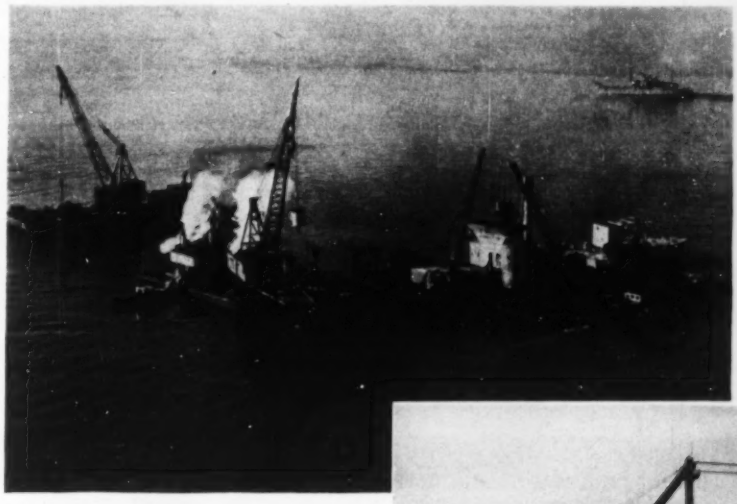
### River sand and gravel used for aggregates

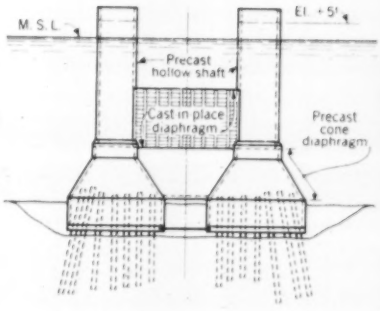
For aggregates, river sand and gravel were chosen despite the fact that they cost more than crushed rock because of their greatly increased workability and smooth flow when placed as tremie concrete.

Cement is barged to the site aboard a bulk cement barge, which also carries the necessary water. Elaborate standby machinery is provided abroad the floating concrete plant to prevent interruption of any pour. Concrete is placed through tremie pipes which are supported on structural steel frames temporarily bolted to the precast concrete bottom bell (Step 4). The tremie pipes are raised with extreme care by means of air hoists, to minimize the formation of laitance. The placing of the rest of the precast units and tremie sequences are illustrated in Steps 5, 6 and 7.

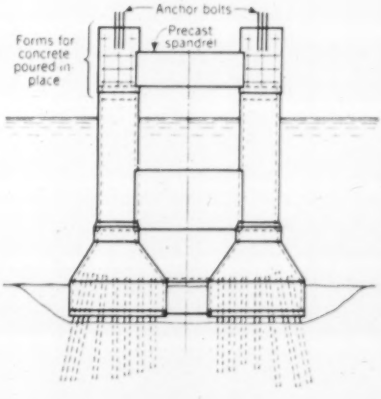
This project is being built under the supervision of the Division of San Francisco Bay Toll Crossings, for which Norman C. Raab is Projects Engineer; Howard F. Topping and Louis J. Jennings, Supervising Bridge Engineers; Oliver R. Bosso, Supervising Engineer; and Ben Balala, Construction Engineer (all of whom are members of ASCE). Mr. H. M. Eichstaedt is Resident Engineer.

The $14,234,000 contract for the substructure was awarded on February 26, 1953, to the joint venturers, Ben C. Gerwick, Inc., and Peter Kiewit Sons' Co. This contract is expected to be completed in October 1955. For the contractor, Donald B. Weaver is the Project Manager and William J. Talbot is the Project Engineer.






**Step 6:**
Precast hollow shafts are placed. Removable steel forms for each side of cast-in-place diaphragm are then secured between them. Next tremie concrete is poured to El. + 5 ft, filling bells, cones, diaphragm, and shafts.




**Step 7:**
Precast spandrel connecting the two shafts is placed, forms are set for shaft tops, and anchor bolts are placed. Finally concrete is poured to final elevation (here about El. + 13), forms are stripped, and concrete cured. Some piers have cast-in-place columns 40 to 50 ft high extending up to El. + 50 or + 60. Others have concrete houses.

**WALTER H. WEISKOPF and JOHN W. PICKWORTH, Members ASCE**

**Weiskopf & Pickworth, Consulting Engineers, New York, N.Y.**

# Concrete and steel framing combined in wide-open bank building

A challenging problem in structural engineering was posed by the unusual design of a branch bank of the Manufacturers Trust Co. now under construction at the southwest corner of 43rd Street and Fifth Avenue, New York, N.Y. Departing from the traditional massive exterior for such structures, the architects suggested an open we-have-nothing-to-hide atmosphere, a treatment that would open to the public view an inviting picture of the financial services available.

This concept called for an uninterrupted glass facade from sidewalk to roof for the entire Fifth Avenue front and for most of the 43rd Street side. The usual exterior columns encased in a masonry enclosure wall were, of course, out of the question, and placing the exterior columns only a few inches behind the glass was unacceptable since such columns would be plainly visible from the outside. Large banking rooms on the first and second floors obstructed as little as possible by interior columns were desired and, in addition, the column arrangement had to be suitable for flexible subdivision for office use on the third and fourth floors and for executive offices on the fifth floor. (See Figs. 1 and 2.) An easement limits the height of the building to 60 ft for a 25-ft strip along the southern side of the property. This height limitation, and the high clear stories desired, necessitated a minimum depth for the floor construction and precluded the possibility of column transfers. In one early study, the columns were placed about 10 ft from Fifth Avenue and the same distance back from 43rd Street. This plan, while suitable for the banking room, was unsatisfactory for the offices above,

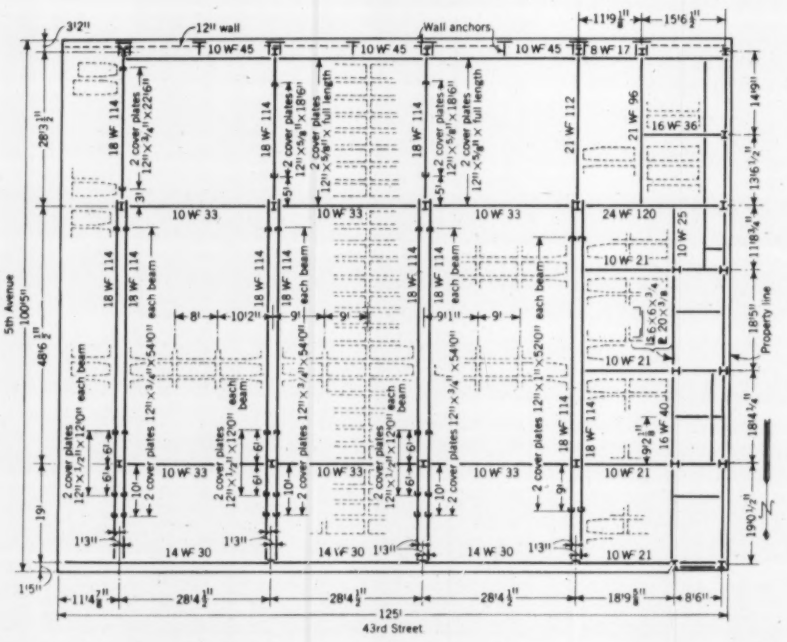



FIG. 1. Third-floor plan illustrates combined steel and reinforced concrete framing. Long span provides open areas at banking levels.

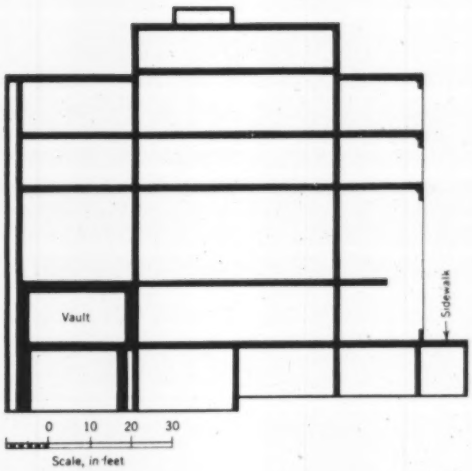
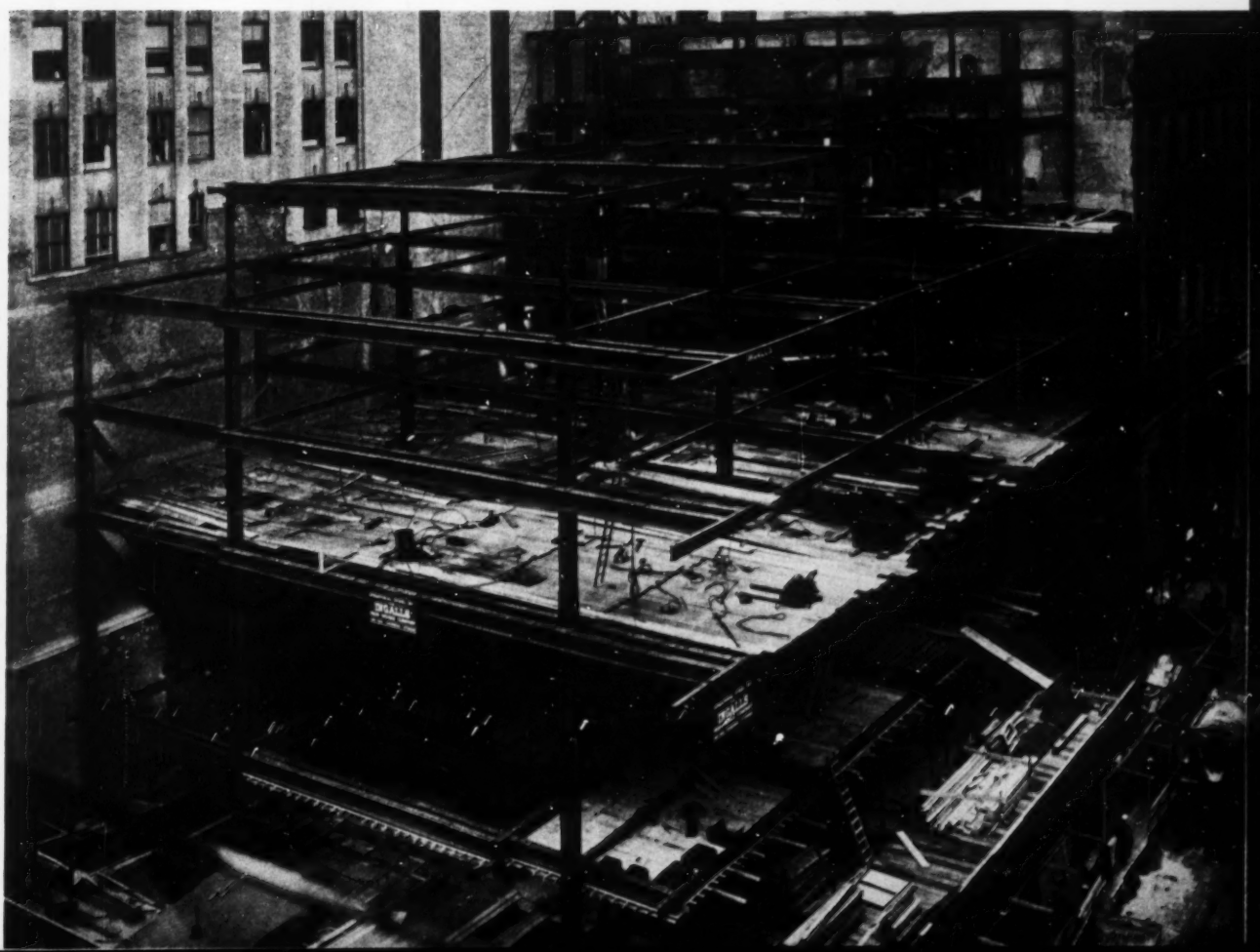



FIG. 2. Sketch of framing from Fifth Avenue front shows integration of structural function with esthetics of open architectural concept.

New Manufacturers Trust Company bank building is being erected at corner of Fifth Avenue (to left) and 43rd Street (to right), New York, N.Y. Framing in east-west direction is of reinforced concrete, here seen being placed.

Structural steel frame nears completion in this view. Steel cantilever to right in upper stories has length of 20 ft. Back span is 48 ft $6^1/_2$ in. Girders are cambered to take dead load.



as it would have unduly limited the valuable outside office layouts. After a number of studies, an arrangement was tried with a line of columns about 20 ft from 43rd Street, and behind this a span of 48 ft 6 in. to the next line. In the other direction, east-west, a 28-ft bay was adopted with the easternmost line of columns about 10 ft from Fifth Avenue. This created a splendid unobstructed banking space (only 8 columns in the banking rooms) and permitted a satisfactory arrangement of the office space above. The fifth floor then becomes one large, unobstructed 48-ft 6-in. bay with no interior columns. Stairs and elevators were grouped along the western end of the lot and here a closer spacing of columns was used. Above the main roof, the elevator machinery, tanks, stair bulkheads, and a cooling tower are also placed along the western side of the property. This close spacing of columns and the heavier framing also serve to increase the rigidity of the entire structure in the east-west direction.

In studying the floor framing with these cantilevers and long spans, it was also necessary to consider the space required for air-conditioning ducts. To avoid the additional depth required if these ducts were to cross under the main girders, a continuous narrow shaft was provided along the south wall. Ducts from a fan room in the basement rising in this shaft could turn into the space between ceiling and floor construction at each level and, extending northward, would never have to cross under the north-south girders. The depth of floor construction between girders was, therefore, also critical. As finally adopted, the girders in the north-south direction having the 20-ft cantilever and the 48-ft 6-in. back arm are steel. In the east-west direction, a reinforced concrete joist construction was employed for the 28-ft spans and the 10-ft cantilever at Fifth Avenue (Fig. 3).

The steel north-south girders are arranged in pairs straddling the columns. They are placed far enough apart so that the full section can pass the columns to resist the large cantilever moments (Fig. 4). Each girder is an 18-in. WF beam with 12-in. cover plates, making a total steel depth of almost 21 in. Because of the cantilever and long back arm, deflections were critical. The girders were cambered for dead-load deflections both at the end of the cantilever and at the center of the back arm. The steel fabricator was quite successful in bending the pieces to fit this reversed curve.

Since the structural design was so closely connected with the architectural and mechanical features, frequent consultations were held with the architects and mechanical engineers, and the design as it evolved was the result of the closest cooperation among the different offices.

The general contractor is the George A. Fuller Co., and the structural steel was furnished and erected by the Ingalls Iron Works Co. The subcontractor for the reinforced concrete work was the Rizzi Construction Co.

The architects are Skidmore, Owings & Merrill, their consultants for mechanical engineering being Syska & Hennessy, and for structural engineering, Weiskopf & Pickworth.

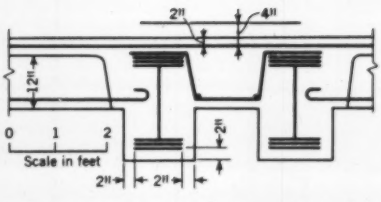



FIG. 3. Section shows position of negative steel in concrete joists as they cross double steel beam. Concrete framing in east-west direction saves floor depth at intersections such as this.

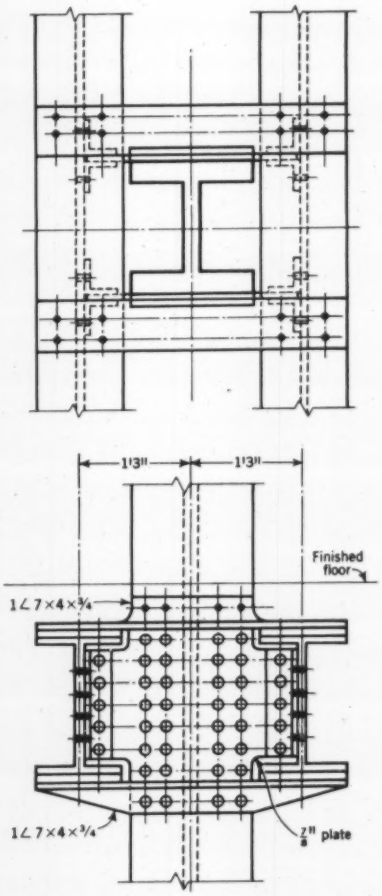
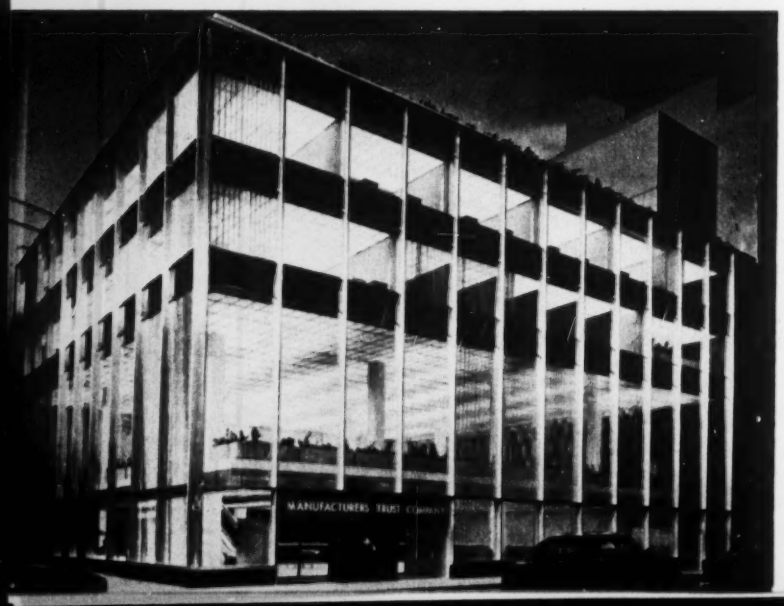



FIG. 4. Column connection shows framing of double cantilever beams to column.




**Left:** Uninterrupted glass facade gives open effect, seen in sketch of completed structure. Plate glass in curtain wall for first three floors is heaviest ever cast. Entrance will be on 43rd Street, just west of Fifth Avenue.

# Supplemental survey of salaries for civil engineering positions

*Report of ASCE Committee on Salaries, 1954*

In the spring of 1953, the American Society of Civil Engineers conducted a periodic survey of prevailing salaries for civil engineering positions. The results were presented in a report by the Society's Committee on Salaries and published in the July 1953 issue of CIVIL ENGINEERING (pages 50–55).

Data accumulated in that survey covered salaries for the nine ASCE grade classifications for professional positions. No attempt was made to assemble information regarding preprofessional work at levels below ASCE Grade I.

## Study initiated

As the result of a number of requests, the Board of Direction, at its meeting in October 1953, "voted to request the Executive Secretary to carry out sufficient inquiry to determine the disparity between subprofessional and professional compensation rates and to refer the results to the Committee on Salaries." That directive has been carried out and the Committee submits this report as to the results.

In order that the data might be appropriate for comparison with the earlier report, inquiry was made only of organizations which supplied salary data for that report. Naturally, educational institutions were not included.

Returns were received in usable form from the following sources:

| Organizations | Data Furnished: No. of Organizations | Data Furnished: No. of Eng. Employees |
|---|---|---|
| Consulting firms | 57 | 1,184 |
| Construction firms | 21 | 636 |
| Railroads | 2 | 202 |
| Public utilities | 2 | 78 |
| Industries | 3 | 8 |
| Total private organizations | 85 | 2,108 |
| State highway departments | 33 | 12,658 |
| Other governmental agencies | 6 | 313 |
| Total public organizations | 39 | 12,971 |
| Grand total | 124 | 15,079 |

There is a marked reduction in the number of returns as compared with those in the earlier survey for professional positions. This is largely because a considerable number of the organizations which received questionnaires do not carry any employees in the lower grades. However, it is believed that the data supplied are of sufficient volume and merit to fully warrant publication.

## Classifications for Preprofessional Grades

Following are the descriptive "Classifications for Preprofessional Grades" in the form submitted with the questionnaire:

### Grade A

Under supervision, with little or no previous experience, to assist with simple routine engineering work in field or office.

Typical tasks are to serve in the field as chainman or flagman, in the office, to index and file plans and survey books, to copy engineering data, to make simple arithmetical calculations or to check and plot level notes.

### Grade B

Under supervision, to do the simpler types of preprofessional engineering work in office, laboratory and field, not necessarily requiring professional engineering training but requiring some experience.

Typical tasks are to serve as rodman on survey or construction work, to make simple survey or construction notes, to do simple level and transit work, to perform simple routine testing, or to do simple engineering office work including arithmetical calculations.

### Grade C

Under supervision, to do engineering work somewhat more difficult than that required in Grade B, in office, laboratory, or field, not necessarily requiring professional engineering training but requiring qualifying experience.

Typical tasks are to make graphs and charts, to perform ordinary engineering computations, to make and check survey and construction notes, to make routine construction drawings, to do level and transit

**TABLE I a. PRIVATE ORGANIZATIONS—Monthly payroll rates at preprofessional grades shown**

Data obtained from survey of December 1953 from 57 consulting firms (1,184 employees)

| ASCE Grade | Orgns Reporting | Entrance Rate, Median | Entrance Rate, Middle 50% | Entrance Rate, Total Range | Orgns Reporting | Max. Rate, Median | Max. Rate, Middle 50% | Max. Rate, Total Range |
|---|---|---|---|---|---|---|---|---|
| | | | | $100 | | | | $125 |
| A | 52 | $208 | $156 | | 52 | $260 | $209 | |
| | | | 238 | | | | 285 | |
| | | | | 350 | | | | 400 |
| | | | | 160 | | | | 180 |
| B | 52 | 260 | 217 | | 51 | 303 | 260 | |
| | | | 300 | | | | 375 | |
| | | | | 400 | | | | 525 |
| | | | | 180 | | | | 200 |
| C | 57 | 282 | 240 | | 55 | 370 | 325 | |
| | | | 312 | | | | 425 | |
| | | | | 433 | | | | 546 |

**TABLE II a. PRIVATE ORGANIZATIONS—Monthly payroll rates at preprofessional grades shown**

Data obtained from survey of December 1953 from 21 construction firms (636 employees)

| ASCE Grade | Orgns Reporting | Entrance Rate, Median | Entrance Rate, Middle 50% | Entrance Rate, Total Range | Orgns Reporting | Max. Rate, Median | Max. Rate, Middle 50% | Max. Rate, Total Range |
|---|---|---|---|---|---|---|---|---|
| | | | | $140 | | | | $180 |
| A | 14 | $275 | $200 | | 12 | $340 | $225 | |
| | | | 325 | | | | 380 | |
| | | | | 400 | | | | 400 |
| | | | | 175 | | | | 200 |
| B | 19 | 300 | 216 | | 19 | 350 | 300 | |
| | | | 350 | | | | 400 | |
| | | | | 388 | | | | 500 |
| | | | | 250 | | | | 300 |
| C | 17 | 400 | 320 | | 17 | 450 | 410 | |
| | | | 450 | | | | 490 | |
| | | | | 500 | | | | 750 |

**TABLE III a. PRIVATE ORGANIZATIONS—Monthly payroll rates at preprofesional grades shown**

(Consulting firms, construction firms and others) Data obtained from survey of December 1953 from 85 private organizations (2,108 employees)

| ASCE GRADE | ORGNS REPORTING | ENTRANCE RATE, MEDIAN | ENTRANCE RATE, MIDDLE 50% | ENTRANCE RATE, TOTAL RANGE | ORGNS REPORTING | MAX. RATE, MEDIAN | MAX. RATE, MIDDLE 50% | MAX. RATE, TOTAL RANGE |
|---|---|---|---|---|---|---|---|---|
| | | | $160 | $100 | | | $209 | $125 |
| A | 71 | $212 | 271 | | 68 | $265 | 325 | |
| | | | | 400 | | | | 400 |
| | | | 216 | 160 | | | 266 | 180 |
| B | 76 | 260 | 340 | | 74 | 318 | 375 | |
| | | | | 443 | | | | 525 |
| | | | 260 | 180 | | | 350 | 200 |
| C | 79 | 303 | 375 | | 70 | 412 | 450 | |
| | | | | 500 | | | | 750 |

**TABLE IV a. PUBLIC ORGANIZATIONS—Monthly payroll rates at preprofessional grades shown**

Data obtained from survey of December 1953 from 33 State Highway Departments (12,658 employees)

| ASCE GRADE | ORGNS REPORTING | ENTRANCE RATE, MEDIAN | ENTRANCE RATE, MIDDLE 50% | ENTRANCE RATE, TOTAL RANGE | ORGNS REPORTING | MAX. RATE, MEDIAN | MAX. RATE, MIDDLE 50% | MAX. RATE, TOTAL RANGE |
|---|---|---|---|---|---|---|---|---|
| | | | $170 | $135 | | | $210 | $170 |
| A | 31 | $182 | 225 | | 31 | $249 | 276 | |
| | | | | 270 | | | | 325 |
| | | | 198 | 150 | | | 250 | 200 |
| B | 31 | 215 | 260 | | 31 | 281 | 316 | |
| | | | | 307 | | | | 375 |
| | | | 250 | 200 | | | 312 | 250 |
| C | 29 | 280 | 300 | | 29 | 342 | 383 | |
| | | | | 349 | | | | 480 |

**TABLE V a. PUBLIC ORGANIZATIONS—Monthly payroll rates at preprofessional grades shown**

(Including State Highway Departments) Data obtained from survey of December 1953 from 39 public organizations (12,971 employees)

| ASCE GRADE | ORGNS REPORTING | ENTRANCE RATE, MEDIAN | ENTRANCE RATE, MIDDLE 50% | ENTRANCE RATE, TOTAL RANGE | ORGNS REPORTING | MAX. RATE, MEDIAN | MAX. RATE, MIDDLE 50% | MAX. RATE, TOTAL RANGE |
|---|---|---|---|---|---|---|---|---|
| | | | $165 | $135 | | | $213 | $170 |
| A | 33 | $183 | 229 | | 33 | $250 | 285 | |
| | | | | 287 | | | | 327 |
| | | | 200 | 150 | | | 255 | 200 |
| B | 36 | 220 | 269 | | 36 | 290 | 327 | |
| | | | | 327 | | | | 375 |
| | | | 260 | 200 | | | 312 | 250 |
| C | 35 | 290 | 324 | | 35 | 351 | 395 | |
| | | | | 376 | | | | 480 |

**TABLE VI. Percentage relationships give comparisons among six sections of the country**

The figures used for this purpose are obtained by determining average of median values for groups covered in Tables I*a*, II*a*, and V*a*

| AREA | PERCENTAGE RELATIONSHIP OF MEDIAN VALUES | | | | | |
|---|---|---|---|---|---|---|
| | Grade A | | Grade B | | Grade C | |
| | Entrance | Max. | Entrance | Max. | Entrance | Max. |
| New England | −36 | * | * | −27 | −17 | −23 |
| Middle Atlantic | −34 | −10 | −11 | − 6 | − 4 | + 1 |
| Southern | −40 | −28 | −18 | −14 | −27 | −24 |
| Middle West | 0 | 0 | 0 | 0 | 0 | 0 |
| West of Miss. | −24 | −22 | −17 | −11 | −22 | −23 |
| Far West | + 9 | + 9 | + 2 | + 7 | + 6 | + 7 |

* Insufficient data

work, to make routine inspections on construction work, or to make routine tests of the properties of soils or materials of construction.

SUPPLEMENTAL NOTE:

The requirements for Grade C are such that there is likely to be some overlapping with respect to those for Grade I of the ASCE professional grade series. Employees at the top of this classification (Grade C) may have graduated from college or possess a reasonably equivalent combination of education and experience. Such men are considered to be in preprofessional work with the full expectation of advancing into a professional grade. Differentiation between these "preprofessional" employees and "subprofessional" employees is based on the premise that the latter do not possess qualifications that will permit them to progress up the ladder of the professional grades.

. . . .

A fundamental prerequisite for Grade I is "professional, scientific, or technical training equivalent to that represented by graduation from a college or university of recognized standing."

Although annual salary rates were given in the previous report, data for the present purpose were requested in terms of monthly compensation. This was done because employees in the lower classifications frequently are not engaged on an annual basis. Results are shown in the accompanying five tables, I*a* through V*a* inclusive, each representing a different group of organizations.

In order that the tabulations may be related readily to those carried in the earlier report, the tables included herewith are arranged in the same order. For instance, Table I*a*, Private Organizations, covers preprofessional positions for the same type of organizations included in Table I of the July report, etc.

With the object of comparing salary rates in different areas, the country has been divided into six sections as indicated on the accompanying map, Fig. 1. These are subdivisions frequently used in analyses of national economic conditions. Percentage relationships are shown in Table VI.

The resulting comparisons are not fully conclusive because of wide variations in the number of organizations reporting from the different sections. However, it is believed that the data are substantially correct.

It will be noted that, in spite of some irregularities, a rather definite pattern appears in Table VI. Salaries in the Southern region are consistently the lowest, with the New England and West of Mississippi areas fairly close in next to the lowest position. The Far West ranks highest in every classification.

It is recommended that the classifications covered in this report be included in the biennial Salary Survey contemplated for 1955.

*Respectfully submitted:*
Carroll A. Farwell
Dewitt C. Greer
Donald H. Mattern
Warren W. Parks, *Contact Member*
Robert J. Ellison, *Vice Chairman*
Henderson E. McGee, *Chairman*

*February 4, 1954*

THOMAS H. DALE, JR., A.M. ASCE

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# Design of continuous foundation still demands engineering judgment

The question of foundations with more than two column loads is one which has been carefully avoided by the authors of our standard textbooks, possibly because no relatively simple method has been devised for its solution. When such a foundation is analyzed as an inverted beam, the shears show that something is amiss because they do not check with the column reaction. The shears for statical moments do agree with the column reaction, but the difficulty with using statical moments is of course that they do not take into account the elastic properties of the beam which constitutes the continuous foundation. This may be compared to the fact that innumerable solutions may be found for a redundant truss which satisfy statics, but only one solution will satisfy both static and elastic requirements. So too for the foundation, a solution must be found which satisfies both the elastic properties of the beam and the soil, and the laws of statics.

On the assumption that the continuous reaction of the foundation is proportional to the settlement plus the deflection, such a solution is possible. The assumption is roughly born out by soil tests. The writer has used the formulas and methods presented by S. Timoshenko (*Strength of Materials*, Part II) for finding the moments and deflections of a continuous foundation. Shears were found by integrating the contact pressure of the soil to which was added or subtracted the shear due to difference in moment. Using this method, the maximum discrepancy between shears at the column and the column load itself was found to be 1.3 percent—an error the writer attributes to using interpolated values and Simpson's rule for the integration.

For purposes of the calculation, the continuous foundation and loading shown in Fig. 1 were assumed. From actual tests on compact sand showing a settlement of 0.2 in. under a load of 6,000 psf, the value of $k$ was determined to be 8,300 psi. Using a concrete beam 3 ft 4 in. wide, with an overall depth of 3 ft 4 in., reinforced by ten No. 9 bars both top and bottom, $I$ was found to be approximately 136,000 in.$^4$ Then $Es/Ec$ was taken equal to 12, and from these data $B$ was calculated to be 0.0088 in.$^{-1}$ In determining the moment of inertia, the concrete was assumed to act only in compression. (This is debatable.)

### Three methods used

Moments, deflections, and shears were then calculated by three methods: (1) on the basis of considering the foundation and the soil elastic, as explained above; (2) by moment distribution, considering the foundation to act as an inverted beam; and (3) by statical moments. In the latter two cases the earth pressure was assumed to be uniformly distributed. The calculations themselves are too lengthy to be printed here, but the results are shown in Fig. 1 and Table I.

Figure 1 gives the moment curves for the three different methods,

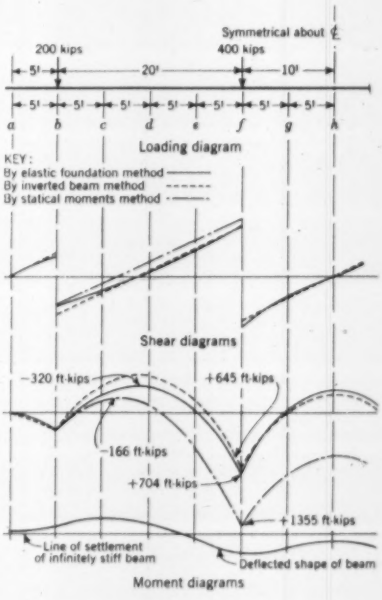


FIG. 1. Results of computations for design of continuous foundation by three methods are shown diagrammatically.

**TABLE I. Results of calculations of moment, shears, and deflections by three methods**

| Location of Sect. | Moment (Ft-Kips) | | | Shears (Kips) | | | Elastic Foundation | |
|---|---|---|---|---|---|---|---|---|
| | Elastic foundation | Moment distr. | Statical moments | Elastic foundation | Moment distr. | Statical moments | Deflection plus settlement (in.) | Soil pressure, kips per sq ft |
| *a* | 0 | 0 | 0 | 0 | 0 | 0 | 0.1630 | 4.9 |
| *b* | +200.5 | +214.0 | +214.0 | (L) + 78.75<br>(R) − 121.25 | (L) + 85.6<br>(R) − 149.8 | (L) + 85.72<br>(R) − 114.28 | 0.1522 | 4.6 |
| *c* | −221.0 | −320 | −142.0 | − 51.5 | − 64.1 | − 28.57 | 0.1348 | 4.1 |
| *d* | −300.8 | −427.0 | − 71.0 | + 18.75 | + 21.62 | + 57.14 | 0.1503 | 4.5 |
| *e* | − 20.5 | −110.0 | +429.0 | +102.5 | +107.3 | +142.86 | 0.1792 | 5.4 |
| *f* | +704.2 | +645.0 | +1355.0 | (L) + 197.2<br>(R) − 197.5 | (L) + 193.0<br>(R) − 171.4 | (L) + 228.58<br>(R) − 171.42 | 0.2152 | 6.4 |
| *g* | − 38.7 | + 2.0 | +712.0 | − 85.0 | − 85.7 | − 85.71 | 0.2012 | 6.0 |
| *h* | −277.6 | −212.0 | +498.0 | − 1.25 | 0 | 0 | 0.1853 | 5.5 |

plotted to the same scale. Also to an exaggerated vertical scale, it shows the deformed shape of the beam as determined by the elastic foundation method. Table I gives the moments and shears as calculated at 5-ft intervals for the three methods, and the settlement plus deflection and unit pressures at 5-ft intervals.

It will be observed that the moment at the cantilever end is practically the same for the three methods, as would be expected, since this moment is statically determinate. However, the moment for the elastic foundation method is somewhat smaller, reflecting the higher pressures under the central portion of the beam. Also, the end of the beam deflects downward because the beam is sufficiently stiff to retain the shape forced upon it by the higher total load of the longer span from $b$ to $f$. In other words, the slope of the cantilever at $b$ is determined by the loading and span from $b$ to $f$, and the cantilever is too stiff to be deflected upward by the load on its short span.

The primary difficulty encountered in considering the foundation as an inverted beam with a uniform load is also apparent from a glance at that part of Table I which shows the unit pressures. Instead of being uniform, the pressures vary from 4.1 kips per sq ft to 6.4 kips per sq ft—a range from the "uniform" pressure of 5.1 kips per sq ft of plus 1,300 lb or minus 1,000 lb. This immediately throws the shears out of line, although the maximum positive moments are only in disagreement by 9 percent.

There is also the difference in elevations of the "supports" (column loads) to consider. The "reaction" at $f$ is 0.2152 − 0.1522 in. = 0.063 in., or $^1/_{16}$ in. lower than that at $b$. Also, at $d$ the negative moment of the inverted beam is 42 percent greater than that for the beam on an elastic foundation. However, the general shape of the moment curve is very similar to that for the elastic foundation, and a design based on the maximum moments would be safe.

### Statical moment results compared

By comparison, the curve of moments and data for the statical moments method does not look too well. As noted before, the moment at $b$ is the same as that obtained by moment distribution, but the moment at $f$ is 110 percent greater than that obtained by moment distribution and 92 percent greater than that resulting from considering the foundation and the soil elastic. At $d$ the negative moment is 76 percent too low. The maximum statical negative moment, 1 ft 8 in. from $c$, is 166 ft-kips, only half of the (elastic foundation) maximum negative moment in the span, 320 ft-kips. The worst feature is that no negative moment at all appears in span $f$-$j$, and a design based on this method would provide no negative steel to take care of the 277 ft-kip negative moment.

### Variation with soil compressibility

The same length of beam and the same moment of inertia were used to compare the effects of a longer cantilever, of equal loads, and of longer spans, and to gain an idea of the difference in moments resulting from a variation in soil compressibility.

Three equal loads of 280 kips were placed on the beam, as shown in Fig. 2. For the second case, the same soil conditions were considered as on the first beam. ($k$ = 8,300 psi and $B$ = 0.0088 in.$^{-1}$) Moments only are given in Table II according to the three different methods of calculation. Approximately the same relationship holds at the cantilever end (here moment at $c$) as held with the first beam.

Moments determined by moment distribution for the inverted beam uniformly loaded are 19 percent higher at $h$ and 21 percent higher at $x$ than those determined by the elastic foundation method. Statical moments give results 34 percent too low at $h$ and 73 percent too high at $x$. The moment distribution method would give a safe design. With the relatively heavier loading near the end of the beam, there are higher soil pressures there than at the central portion, a reversal of the case for the first beam.

For Case 3, the same loading (shown in Fig. 2) and the same moment of inertia were then considered as acting on a soil three times as compressible ($y$ = 0.6 in. at 6,000 psf). Since both soil mechanics theory and test data demonstrate that large areas settle more than small ones under the same unit loading, this might also be considered as a case where test data, obtained from a small plate, are applied to a relatively wide foundation.

Table II shows that for a 300-percent increase in compressibility of the soil, maximum positive and negative moments both increase about 27 percent, for the particular beam considered. This indicates, as would common sense, that with stiffer soils we have less bending because more of the load is transmitted to the soil through direct bearing.

The inverted-beam method and statical moments both give results 18.5 percent low at the cantilever end as compared to Case 3. However, if the greatest positive and negative moments are used for the design of the reinforcing, as is usually the case, it appears that the inverted beam or moment distribution method would give results which are off 13.4 percent, while statical moments would give positive steel deficient by 18.5 percent, and negative steel exceeding the requirements by 42 percent.

All comparisons and percentages given here should be considered approximate only, for the beam on an

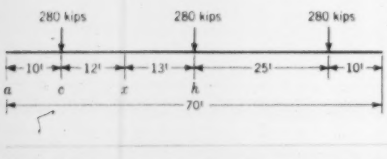


FIG. 2. Loading diagram for Cases 2 and 3 is secured by applying three equal loads to beam of same length as in Fig. 1.

**TABLE II. Results of calculations for moment, in ft-kips, for 300-percent increase in soil compressibility**

| Location of Sect. | Elastic Found., Case 2 ($y$ = 0.2 in.) | Elastic Found., Case 3 ($y$ = 0.6 in.) | Increase in Moment for 300% Incr. in Settlement | Moment Distribution | | | Statical Moments | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Moment | % error for Case 2 | % error for Case 3 | Moment | % error for Case 2 | % error for Case 3 |
| $c$ | +579 | +736 | 27% | +600 | 3.6% high | 18.5% low | +600 | 3.6% high | 18.5% low |
| $x$ | −265 | −342 | 26.5% | −321 | 21% high | 0.9% low | −460 | 73% high | 42% high |
| $h$ | +533 | +617 | 16% | +637.5 | 19.5% high | 3.3% high | +350 | 34% low | 43% low |

elastic foundation taken as the criterion had equal amounts of steel in top and bottom. With unequal amounts, the moment of inertia would change, which would somewhat affect the results.

### No analysis foolproof

It is doubtful that any analysis can represent exactly the true moments developed in a continuous foundation. There are too many variables. Neither the soil nor the concrete is perfectly elastic. Soil tests are indicative of the bearing capacity, compressibility, and shear values of the soil but are not exact. And they may hold true at one end of a foundation but not at the other. At the end of 30 days concrete may have greater or smaller compressive strength than that assumed and specified. At the end of a year the strength is usually much greater because of good curing conditions for most foundations. Certainly some of the concrete acts in tension. There is also the plastic flow of concrete under long-time loads to consider.

Nevertheless, the writer believes that for a continuous footing on soil or on piles, the closest approach to those figures which serve as the best guide to judgment is an analysis based on the elastic properties of the soil. These properties should be determined by tests of the particular soil or piles at the site (the "elastic foundation" discussed above). The determination of moment alone by this method is not too time consuming. If shears are required, however, the time approximately triples. The primary difficulty is that the moment of inertia must be known before the external moments can be found.

In lieu of this, it is suggested that the inverted-beam method be used, with variable loading adjusted by inspection and trial so that the shears at the "supports" (column loads) approximately check. Moments determined from this loading will be closer to those of the "elastic-foundation" method than will moments determined by any other means using uniform loading. In determining the final size of the foundation and its reinforcement, the moments should be weighed along with the designer's thumb.

Test data on actual foundations would be a great aid in selecting or adjusting the method to be used for design. Unfortunately, as far as the writer knows, none exists. In the meantime we must rely, more heavily than perhaps we have realized, on the factor of safety.

# Simplifying compression reinforcing design

JACK MOYSE, Consulting Engineer, Louisville, Ky.

Engineers are forever trying to simplify design procedures. The following method is offered in an attempt to clarify the design of compression reinforcing.

First, consider the value of $kd$. It is obvious that the addition of compression reinforcing steel in a percentage that will exactly balance the amount of tension reinforcing which exceeds a balanced design will not affect the value of $kd$. If the amount of compression reinforcing exceeds that balanced ratio, the value of $kd$ will be changed but will not affect the design in any way except economically. Therefore, $A'_s$ can be directly computed by selecting the value of $k$ for balanced design from any handbook, and inserting it in the following equations. Equations 1 and 2 can be derived by direct proportion and inspection of a straight-line stress diagram.

Let $A_x$ = additional tension reinforcing in excess of a balanced design, and $M_x$ = residual moment not taken by the concrete. ($M_x$ = actual moment in inch-pounds $- Rbd^2$.)

Then
$$A_x = \frac{M_x}{f_s(d-d')} \qquad (1)$$

and by direct proportion,

$$A'_s = A_x \left(\frac{n}{n-1}\right)\left(\frac{1-k}{k-d'/d}\right) \qquad (2)$$

(See similar equation in the Concrete Reinforcing Steel Institute Handbook, page 25.)

For example, let $M$ = 320 ft-kips.

$b$ = 17 in.
$d$ = 31 in.
$d'$ = 2 in.
$d'/d = 0.064$ and
$(d - d') = 29$
$f_s$ = 20,000 psi
$n$ = 10
$f_c$ = 1,200 psi
$k$ = 0.375
$R$ = 197 } balanced design
$P_b$ = 0.0113
$(1 - k) = 0.625$
$(k - d'/d) = 0.311$
$bd^2 = 16{,}337$

$$M = 320 \times 12 = 3{,}840 \text{ in.-kips}$$

$$\frac{Rbd^2}{1{,}000} = 197 \times 16.337 = 3{,}218$$

$$\text{Residual moment} = 622 \text{ in.-kips}$$

$$A_x = \frac{622}{20 \times 29} = 1.07 \text{ sq in. (Eq. 1)}$$

$$A'_s = 1.07\left(\frac{10}{9}\right)\left(\frac{0.625}{0.311}\right) = 2.39 \text{ sq. in. (Eq. 2)}$$

$$A_s = A_x + P_b bd = 1.07 + (0.0113 \times 527) = 7.03 \text{ sq in.}$$

For a similar example, see the Reinforced Concrete Design Handbook of the American Concrete Institute, page 9. The equations used above are similar to various others, such as for example, that for the coefficient $c$ used in the Reinforced Concrete Design Handbook, except that derivations are here simplified and clarified.

# Nomogram solves parabolic empirical equations

STEPONAS KOLUPAILA

Associate Professor of Civil Engineering, University of Notre Dame, Notre Dame, Ind.

Empirical equations are computed from observational data in many fields of engineering. A most convenient form is the parabola,

$$x = a(y + b)^n$$

often used for discharge curves of rivers and channels. The constants $a$ and $b$ can be determined after plotting $\sqrt[n]{x}$ against $y$ and straightening the experimental points. For that purpose the power $n$ must be found first.

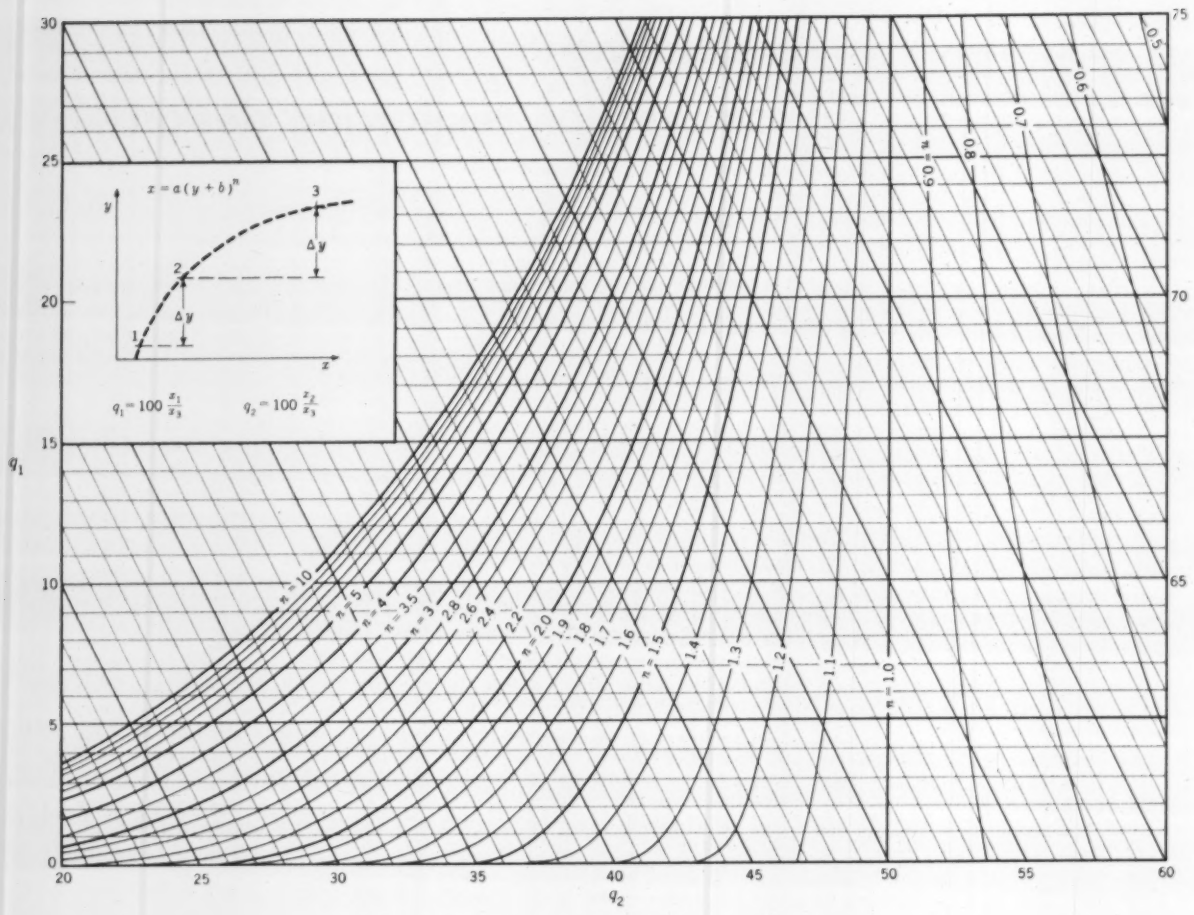


FIG. 1. Nomogram gives power of parabolas, $n$, for various values of $q_1$ and $q_2$.

The nomogram presented here makes it easy to find that power from an approximate free-hand curve, taking three points at equal vertical distances, $y$, and reading three corresponding values of $x$: $x_1$, $x_2$, and $x_3$. The ratios, $q_1 = 100\ x_1/x_3$ and $q_2 = 100\ x_2/x_3$ are the arguments of the nomogram. The value of $n$ is to be read at their intersection.

For example, take:

$x_1 = 48$; $y_1 = 1.00$
$x_2 = 300$; $y_2 = 3.00$
$x_3 = 800$; $y_3 = 5.00$
$q_1 = 100 \times 48/800 = 6.0$
$q_2 = 100 \times 300/800 = 37.5$

From the nomogram, $n = 2.20$.

The equation of a straight line would be, for example,

$$\sqrt[2.20]{x} = 3.78\ (y + 0.53)$$

and the equation of the parabola,

$$x = 18.68\ (y + 0.53)^{2.20}$$



## How would you do it?

*Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor —H. J. Gilkey*

Early in 1938 the Puerto Rico Reconstruction Administration approved the drainage of approximately 400 acres of land at Central Lafayette, a sugar-producing property near Arroy, P. R. The irrigation part of the project necessitated construction of 6,000 ft of 26-in.-dia high-pressure pipeline for pumping 4,000 gpm from a pumphouse in a very swampy area to a 10-acre-ft reservoir. The reservoir was 115 ft higher than the proposed pump site. The question arose as to what type of high-pressure pipe—steel or concrete—to employ in the construction of the pipeline; and if concrete was used whether it should be precast or poured in place. How would you do it? For solution, see page 106.

EDITOR'S NOTE: This is the 23rd installment of a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April 1952 issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H.J.G.

The above problem was submitted by WILBUR E. LAND, A.M. ASCE, Ft Belvoir, Va.

# THE READERS WRITE

## Error in AASHO bridge specifications pointed out

To the Editor: An error in the present AASHO bridge specifications for steel columns (1953 edition, pp. 288–293) is worth bringing to the attention of designing engineers because it causes indicated allowable loads to be as much as 50 percent above the correct allowable loads.

These specifications are valuable compared to other standard specifications in that known eccentricities which vary linearly with column length are accounted for in the determination of column load. However, the assumption of these specifications that the distribution of eccentricities from imperfections is always geometrically similar to the distribution of known eccentricities is incorrect and unsafe. The specifications are rendered correct by substituting this definition of $\alpha$ (using the notation of the specifications) for the existing definition:

$$\alpha = \frac{\frac{e_s c}{r^2} + 0.25}{\frac{e_g c}{r^2} + 0.25}$$

The writer would be glad to send those interested a copy of a more complete discussion of this correction which he has prepared for his students.

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*Assoc. Prof. of Civil Engineering*
*University of Connecticut*

*Storrs, Conn.*

## Praise for ASCE Committee on Engineering Education

To the Editor: I wish to commend the ASCE Committee on Engineering Education for its clear statement of objections to the report of the ASEE's Committee on Evaluation of Engineering Education, as printed in the February issue, pages 65 and 66.

One cannot quarrel with the premises of the ASEE report. Tremendous strides will continue to be made in the physical sciences. The engineering student needs the three basic sciences and nine fundamental engineering sciences as preparation for a career in analysis and design. He also needs the broadening studies to round out his life as a citizen in his community.

The idea behind the ASEE report of having three standards for accreditation of engineering curricula would certainly lead to confusion in the minds of students, parents, and the public generally. It would open the way to a consideration of the accredited programs as First Class, Second Class, and Third Class, and it would be difficult later to extricate the ECPD from this position.

While the report does not say so, it seems to infer either that any raising of standards would result in loss of accreditation by some colleges, or that an effort is under way to accredit many institutions not already included because of their poor standing. Actually loss of accreditation is the surest way of focusing attention on curricula and receiving sympathetic aid from administrators towards rebuilding courses, faculty, and laboratory equipment. Some medical schools had such decisions to make several years ago, and in general the profession was benefitted.

It seems to me that there are certain established considerations upon which an engineering curriculum must be constructed —basic sciences, fundamental engineering courses, analysis and design sequences, laboratory facilities, eminence of faculty, buildings, and library facilities. To short-circuit some of these is to cheat the students of a proper education.

Samuel B. Folk, M. ASCE
*Professor of Mechanics*
*Ohio State University*

*Columbus, Ohio*

## Special slide rule determines stirrup spacing

To the Editor: Mr. Hoff's article in the February issue outlines a method for spacing stirrups using an ordinary slide rule. While his method is not difficult, I believe designers will appreciate a special slide rule developed by Ceco Steel Products Corp. This rule, called a "stirrup calculator," determines the number, size, and spacing of stirrups required.

The method used in determining the spacing is identical to that of Mr. Hoff but is carried a step further to give the spacing between the stirrups rather than the distance of each individual stirrup from a base line.

The triangle of excess shear which is to be carried by the stirrups, and the distances to each stirrup as measured from the apex of the triangle, are shown in Fig. 1.

Assuming that $N$ is the number of stirrups, then the spacing of the fourth stirrup (the distance between the fourth and fifth stirrups) would be

$$S = \frac{A}{\sqrt{N}}\left(\sqrt{4\tfrac{1}{2}} - \sqrt{3\tfrac{1}{2}}\right)$$

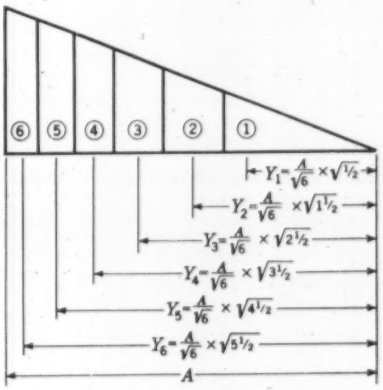



FIG. 1. Triangle of excess shear carried by stirrups and distances to each stirrup.

The spacing of the $N'$ stirrup would be

$$S = \frac{A}{\sqrt{N}}\left(\sqrt{N' + \tfrac{1}{2}} - \sqrt{N' - \tfrac{1}{2}}\right)$$

The slide rule has scales for $A$, $N$, $N'$, and $S$, and solves the formula:

$$\text{Log } A - \text{Log } \sqrt{N} + \text{Log } \left(\sqrt{N' + \tfrac{1}{2}} - \sqrt{N' - \tfrac{1}{2}}\right) = \text{Log } S$$

The spacing of each stirrup can therefore be read directly off the slide rule opposite $N'$.

Ceco has a small quantity of these slide rules which are being distributed to engineers and architects in the building field. A sheet of detailed explanations and directions, with examples, is furnished with each rule.

Ward M. Dobbin, *Sales Engineer*
*Ceco Steel Products Corp.*
*5601 West 26th St.*

*Chicago 50, Ill.*

# SOCIETY NEWS

The Chalfonte-Haddon Hall Hotel, headquarters for the Atlantic City Convention, June 15-18, is shown here in aerial view.

## Philadelphia Section Plans Program for ASCE Atlantic City Convention

With "Delaware Valley, U.S.A.," as the Convention theme, the Philadelphia Section is arranging a program for the Society's Atlantic City Convention that promises to make it outstanding among ASCE meetings. Convention headquarters will be the Chalfonte-Haddon Hall hotel, where fine accommodations will be available to all.

General Chairman Oliver W. Hartwell and the many Convention committee members urge engineers not to let anything interfere with plans to attend the Convention. They promise everything within their power to make the Convention a vacation treat for the whole family. Always a pleasant resort, Atlantic City will be at its best in June, they say. The fact that the host city is observing its one-hundreth anniversary this year as "New Jersey's Playground to the World" is another inducement.

### Civil Engineering Week

The entire week beginning June 13 will be proclaimed "Civil Engineering Week" by Mayor Joseph Altman in recognition of the contributions made by the profession to the advancement of science and the welfare of mankind. The Hon. Robert B. Meyner, governor of New Jersey, will be guest of honor and principal speaker at the general luncheon on June 16.

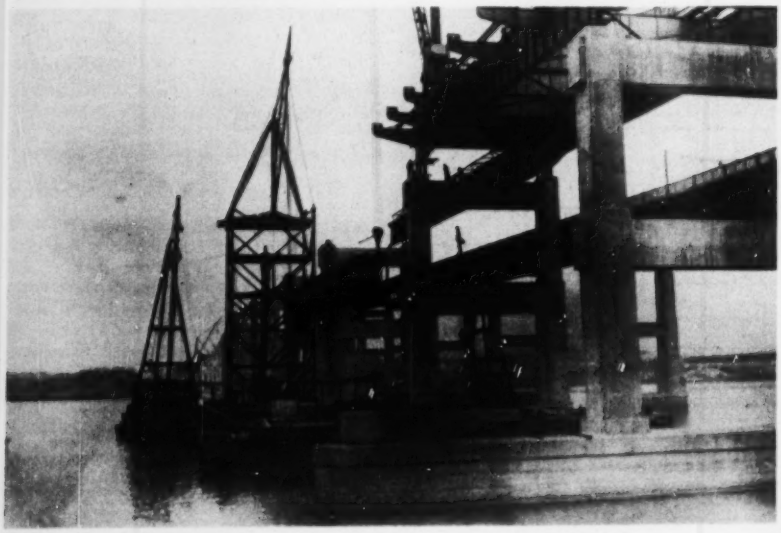
### Interesting Technical Program Arranged

The Technical Program Committee is leaving no stone unturned to assure that the technical sessions of the Convention will be interesting as well as educational. The twenty sessions scheduled will include a symposium on Wednesday morning, June 16, keyed to the Convention theme. The Philadelphia–Delaware–South Jersey section of the Delaware Valley borders on the nation's largest fresh water port and is currently the fastest growing industrial area in the world. Many of the nation's key industries, including the new Fairless works of the United States Steel Corporation (said to be the largest single integrated steel plant ever built at one time) are located in the area. With such a rich background of material to draw upon, the symposium panel will have some interesting papers. Topics under study will be "Regional Planning and Highways," by Edmund N. Bacon, executive director, Philadelphia City Planning Commission; "Water Supply Problems," by Francis S. Friel, consulting engineer, Philadelphia; "Stream Pollution Control," by H. E. Moses, director, Bureau of Sanitary Engineering, Pennsylvania Department of Health, Harrisburg; and "The Delaware Estuary," by Clarence F. Wicker, chief, Engineering Division, Philadelphia District Engineer Office.

### Two Inspection Trips Planned

Present arrangements call for two interesting inspection trips. For Thursday, a bus ride over a part of New Jersey's Garden State Parkway, now under con-

Structures on the Garden State Parkway, objective of an all-day inspection trip during the Society's Atlantic City Convention, include this $11,000,000 bridge that will carry the Parkway across the Raritan River between Sayreville and Woodbridge Township. The 4,400-ft bridge, longest on the 165-mile Parkway, is scheduled for opening next July. In this view engineers and erectors are hoisting and setting the first massive steel girders on piers. Each girder is approximately 245 ft long and weights about 188 tons.



struction, is planned. An all-day boat trip on the Delaware River between Philadelphia and Trenton is tentatively scheduled for Friday. The trip will give a boat's-eye view of the Fairless Works at Morrisville.

#### Many Special Events on the Agenda

The Entertainment Committee, with Joseph R. Farrell as chairman, promises that the social program will take into account all ages and tastes. For the ladies, in addition to the Wednesday evening dinner dance, there will be luncheons and bridge and bingo parties at the Atlantic City and Seaview Country Clubs, a fashion show, an exhilarating boat ride along the New Jersey shore, and "a few surprises." There will also be plenty of time for shopping and sightseeing and for strolls and rides on the Boardwalk. A number of special events are also being arranged for the men.

#### Full Program in the May Issue

The entire Convention program, including technical sessions, social events, inspection trips, and other pertinent information, will be published in the May issue of CIVIL ENGINEERING. In the meantime, reservations may be made early by simply dropping a line to the Reservations Committee, ASCE Convention, Chalfonte-Haddon Hall, Atlantic City, N.J.

## Varied Program Planned for Pacific Southwest Conference

Final details of the program for the Seventh Annual Pacific Southwest Conference, to be held at the Hotel Senator in Sacramento, April 28–May 1, have been worked out by committees of Sacramento Section members under the general chairmanship of R. Robinson Rowe. Registration will begin Wednesday afternoon, April 28 (2 to 6 p.m.) and continue through Thursday and Friday. There will be a $3.00 registration fee for everyone except the ladies and students.

The conference proper will open Thursday morning, 9 a.m., with a welcome by Mr. Rowe and greetings from the Section by C. A. Eckland, president of the Section. The conference will then (9:30) get down to serious business with a technical session occupying the remainder of the morning. Subjects and speakers will be: "Planning and Design of the Phoenix Sky Harbor Airport," by Walter Johannessen; "Design of Large Booster Pumping Stations," by Harold W. Yost; "Weldable Structural Steels," by A. L. Elliott; and "Design of a Parallel Carquinez Bridge," by C. H. Darby; and "Equitable Building Design," by J. Albert Paquette.

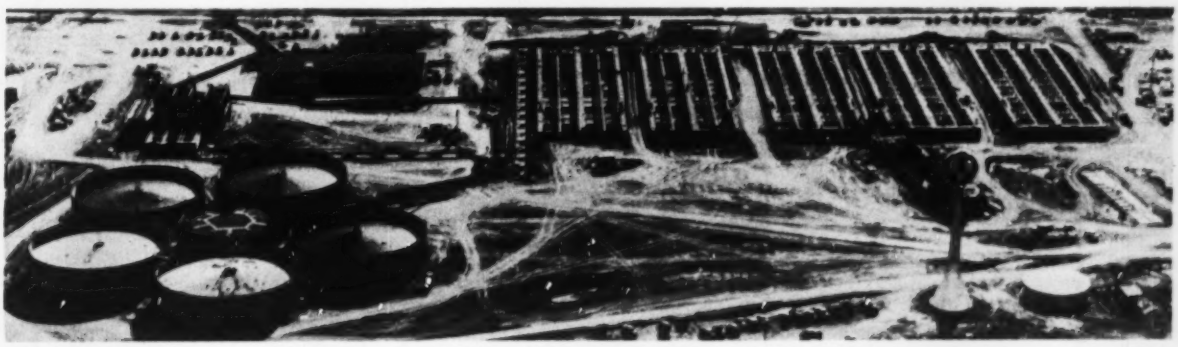
The first Thursday afternoon session, beginning at 2 o'clock, will be devoted to Society problems and will feature discussion of "Organization of Local Section Technical Divisions," headed by Ralph G. Wadsworth; "Procurement of Professional Engineering Services," by S. B. Barnes; and "Employer-Employee Relationships," by the Junior Forum of the Los Angeles Section. Sterling S. Green, president of the Los Angeles Section, will preside. Another Thursday afternoon session, beginning at 3 o'clock, will consist of papers on "Pit No. 4 Project—Pacific Gas & Electric Power Co.," by T. J. Corwin, Jr.; "Service Behavior of Rock-Fill Dams," by L. M. Greenleaf and J. P. Hawke; and "Construction of Etiwanda Steam Plant," by W. L. Chadwick.

Technical papers scheduled for Friday morning (9 to 10:30) deal with "Water and Power from the Upper Colorado River," by C. B. Jacobson; "Direct Measurement of Differential Settlement," by R. L. Sloan; and "Klamath River Water Problems," by Lewis A. Stanley. The remainder of Friday morning will be devoted to a business meeting; a Junior Conference, featuring a "Symposium on Professional Registration Examinations," conducted by the Junior Forum of the Sacramento Section; and a Student Chapter Conference.

On the Friday afternoon agenda (1:30 to 3:00) are papers on the Richmond-San Rafael Bridge, by N. C. Raab; "Sacramento Sewage Treatment Plant," by R. R. Kennedy; and "Design and Construction of Folsom Dam," by Frank Kochis and Horace A. Johnson. The annual Student Paper Contest, with the University of Nevada Student Chapter as host, is set for 3:00 o'clock. Student prize awards will be made at the Conference Banquet to be held Friday evening ($4.00 per plate, and $3.00 for students).

In addition to the two-day technical program, which is headed by Stewart Mitchell, the conference will offer an exhibit of engineering models; a Saturday inspection tour of major construction projects in the Sacramento area (including the Sacramento Treatment Plant, the Nimbus Afterbay Project and Folsom Dam); and numerous less serious events, such as a Get-Acquainted Party sponsored by the Sacramento Section on Thursday evening. ASCE President Daniel V. Terrell will be the featured speaker at the informal Conference Banquet on Friday evening. There will also be luncheons both Thursday and Friday; special breakfasts; and a box-social picnic during the Saturday inspection trip.

The visiting ladies will find their time well taken by tours of such points of interest as the State Capitol, the Governor's Mansion, and the E. B. Crocker Art Gallery, and a shopping trip to Town and Country Village. They are especially



Sacramento Treatment Plant, which is scheduled for completion this summer, is on the all-day tour of engineering projects concluding the Pacific Southwest Conference on Saturday, May 1. A box-social picnic, arranged by the Junior Forum of the Sacramento Section, will be enjoyed on the tour, which will take in Folsom Dam and the Nimbus Afterbay Project

invited to attend the Thursday luncheon and the Saturday excursion and picnic, in addition of course to the Get-Acquainted Party Thursday evening and the Conference Banquet Friday evening. Mrs. R. Robinson Rowe is chairman of the ladies' program.

Hotel reservations will be available either at the Senator, the conference headquarters, or the Hotel Sacramento, which is only a block from the headquarters hotel. Rates at the Senator are $6-12, single; $8-12, double; and $10-15, twin. Rates at the Sacramento are $5–6, single; $7–8, double; and $8–11, twin. Requests for reservations should be sent to D. H. Rutledge, Reservation Chairman, Box 197, Town and Country, Sacramento 21, Calif. A $5 deposit is required.

Sub-hosts to the conference are the Sacramento Section's Subsections (Central Valley, Eastern Sierra, Marysville, Nevada, and Shasta); the Sacramento Junior Forum; the University of Nevada Student Chapter; and the Sacramento Speakers' Club.

## Five Cincinnati Societies Aid Development Program

Five major engineering societies in the Cincinnati industrial area met recently to launch a joint professional development program, as part of the ECPD Professional Training program for young graduate engineers, to be known as the "First Five Years of Professional Development." Local sections of the ASCE, AIChE, AIEE, and ASME joined with the Engineering Society of Cincinnati in staging the program.

Sidney D. Kirkpatrick, past-president of AIChE and a vice-president and editorial director of the McGraw-Hill Book Co., was keynote speaker with a talk entitled, "At the Threshold of an Engineering Career." The audience was then divided into eight groups for round-table discussion of the six points of the ECPD program. Subjects discussed included: (1) Orientation and Training in Industry; (2) Continued Education; (3) Integration into the Community; (4) Professional Registration; (5) Self Appraisal; and (6) Selected Reading.

The meeting was a feature of an ECPD pilot study, known as the "Community Project in Professional Development," which is emphasizing the importance of related activities of industry, the engineering societies, and universities on a community basis in a typical industrial area.

## Engineering-Scientific Manpower Agencies Back Appley Report

Support for the Appley Committee report on manpower resources, which recommends a fundamental reorganization of the nation's military reserves, is announced by the Engineering Manpower Commission of Engineers Joint Council, the Scientific Manpower Commission, and the Manpower Committee of the American Chemical Society. The three agencies represent technical societies with a total membership of more than 300,000 scientists and engineers.

The report, entitled "Manpower Resources for National Security," was prepared for the Office of Defense Mobilization by its Committee on Resources for National Security under the chairmanship of Lawrence A. Appley. Its principal recommendations include the creation of an "immediately recallable reserve" and a "selectively recallable reserve." Proposals based on the report have been submitted to President Eisenhower by Dr. Arthur S. Flemming, director of the Office of Defense Mobilization, and at the President's request are now being formulated into a definite program for presentation to the National Security Council.

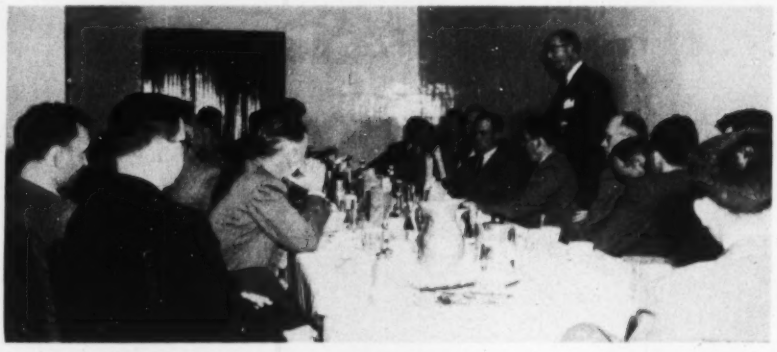
Pointing out that they have been gravely concerned for the past several years with the relationship of the nation's specialized manpower to its overall manpower reserve structure, the three agencies acclaim the report as offering a much needed "fresh approach" to the manpower mobilization problem. Specifically the statement praises the following four recommendations of the report:

1. Reorganization of the military reserve forces to provide for an immediately recallable reserve and a selectively recallable reserve.
2. Continuing screening of those in the immediately recallable reserve for occupational and other reasons.
3. Provision for expert advice to the agency responsible for mobilizing the selectively recallable reserve.
4. Recall, in general, of specialized personnel only in accordance with demonstrated need.

The immediately recallable reserve, as envisioned by the Appley Committee report, would consist of men with a high level of military competence who would be called up at any time without disrupting the civilian economy. The selectively recallable reserve would consist of reservists who possessed civilian skills of more importance to the national security than their military skills or who, for some other reasons, might not be available for immediate call-up.

The scientific and engineering societies have consistently held that reservists with specialized training and experience should be recalled to military service only when their special skills are needed by some branch of service. Indiscriminate recall of such men, it is contended, tends to hamper research, development and production and so to weaken the overall national strength.

## *Virginia Surveyors Hear Vice-President Earnest*



**Surveyors attending a five-day refresher course at Virginia Military Institute are addressed by G. Brooks Earnest, Vice-President of ASCE and president of Fenn College, who praised their interest in the profession and advised of the Society's achievements in protecting the professional status of engineers. Col. R. A. Marr, Jr., M. ASCE, professor and head of the department of civil engineering, directs the refresher course, which is sponsored by the Virginia Department of Highways, the League of Virginia Municipalities, the Virginia Association of Surveyors, and the State Board of Education.**

# ASCE Structural Division and Kansas City Section Schedule Structural Conference

May 13 and 14 are the dates of a new endeavor of the ASCE Structural Division and the Kansas City Section — a Structural Conference to be held at the Hotel Continental in Kansas City. Planned to meet the needs of ASCE members in the area whose primary field of interest is structural engineering, the conference is of course open to all interested engineers. Facilities for housing any who are able to travel from a distance to participate will be available at the headquarters hotel.

A full listing of speakers and subjects, together with other pertinent information, is given here.

## Program

### THURSDAY, MAY 13, 1954

**Registration, 8:30 a.m.**

Registration in Roof Garden, 22nd floor. No registration fee required. Obtain luncheon, dinner, and trip tickets at registration desk. Please register regardless of arrival time.

### Morning Session

**Roof Garden** **22nd Floor**

9:45 **Meeting called to order**

RICHARD R. TIPTON, President, Kansas City Section

*Presiding: Geo. W. Bradshaw, Chairman, Department of Civil Engineering, University of Kansas, Lawrence, Kans.*

10:00 **Vibration as it Affects Structures Supporting Rotating Machines**

H. H. BENJES, Head of Civil Engineering Department, Black and Veatch, Consulting Engineers, Kansas City, Mo.

11:00 **A New Application of Flexibility Factors to Simplify Moment Distribution**

LEO D. BOSWELL, Structural Designer, Burns and McDonnell, Consulting Engineers, Kansas City, Mo.

**Discussion**

12:15 **Luncheon, Continental Room, sixth floor**

**Greetings from the Kansas City Section**

RICHARD R. TIPTON, President
MAYOR WILLIAM E. KEMP

### Afternoon Session

**Roof Garden** **22nd Floor**

*Presiding: C. Kelsey Mathews, Burns and McDonnell Eng. Co., Kansas City, Mo.*

2:00 **Lightweight Aggregates for Structural Concrete**

ADRIAN PAUW, Associate Professor of Civil Engineering, University of Missouri, Columbia, Mo.

3:00 **Structural Imagination—the Design and Construction of Thin Shells**

M. G. SALVADORI, Professor of Civil Engineering, Columbia University, New York, N.Y.

**Discussion**

4:00 **Foundation Failures in Residences and Small Structures—the Cause, Correction and Prevention**

KARL V. TAYLOR, Chief, Foundation and Materials Branch, Corps of Engineers, U.S. Army, Kansas City District

### Social Hour, 7:00 p.m.

**Georgian Room** **5th Floor**

An opportunity to meet old and make new friends. Bar facilities provided.

### Dinner, 8:00 p.m.

**Continental Room** **6th Floor**

**Toastmaster,** REED MCKINLEY, Director of Public Works, Kansas City, Mo. C. EARL HOVEY, Patent Attorney, will speak on "Patent Ingenuity—Serious and Otherwise"

The ladies are cordially invited to be present at the Social Hour and Dinner. Dress, informal.

### FRIDAY, MAY 14, 1954

### Morning Session

**Roof Garden** **22nd Floor**

*Presiding: N. T. Veatch, Black and Veatch, Kansas City, Mo.*

8:30 **Prestressed Concrete, Pro and Con**

C. H. SCHOLER, Head, Dept. of Applied Mechanics, Kansas State College, Manhattan, Kans.

9:30 **Distribution of Wheel Loads to Bridge Stringers**

FRANK M. KEREKES, Assistant Dean, Division of Engineering, Iowa State College, Ames, Iowa.

**Discussion**

10:15 **Precast Concrete Bridge Units**

HENRY G. SCHLITT, Deputy State Engineer, Dept. of Roads & Irrigation, Lincoln, Nebr.

11:00 **Paseo Bridge Project**

R. N. BERGENDOFF, Partner, Howard, Needles, Tammen & Bergendoff, Kansas City, Mo.

**Discussion**

11:30 **The Design of the Paseo Bridge**

JACOB KAROL, Design Engineer, Howard, Needles, Tammen & Bergendoff, Consulting Engineers, Kansas City, Mo.

**Discussion**

12:30 **Luncheon, Continental Room, 6th Floor**

### Afternoon Tour

2:30 **Field Trip and Tour, Paseo Bridge Project**

A fine opportunity to view the actual design and construction of this outstanding project. It is suggested that everyone make use of the buses provided so that the guides and commentators can keep us properly grouped. Please be at the 11th Street entrance of the hotel at 2:30 p.m. promptly. Chartered buses have been reserved for your convenience.

### Hotel Reservations

The conference headquarters is the Hotel Continental. Requests for reservations should be sent to:

Mr. JACK F. DAILY, Chairman of Registration, ASCE Structural Conference, Hotel Continental, Kansas City, Mo.

### Officers and Committees

**Executive Committee Structural Division**

Ruben N. Bergendoff, *Chairman*
Jewell M. Garrelts, *Secretary*
Geo. E. Brandow — Warren Raeder
E. C. Hartmann — M. N. Quade

**Local Sections of District 16**

**Colorado, Denver:** O. O. Phillips, *Pres.*
**Iowa, Ames:** Neil Welden, *Pres.*
**Kansas, Topeka:** Emery Bond, Jr., *Pres.*
**Missouri, Kansas City Section:** Richard R. Tipton, *Pres.*
**Nebraska, Lincoln:** D. D. Lewis, *Pres.*
**Wyoming, Laramie:** D. W. Morrison, *Pres.*

**Kansas City Section**

President, Richard R. Tipton
1st Vice Pres., Glenn E. Hands
2nd Vice Pres., Waldo R. Kell
Sec.-Treas., Theo. J. Cambern
Director, William G. Riddle
Director, L. W. Bremser
Director, Carter Callahan

**Conference Committees**

**Executive:** W. R. Kell, S. J. Callahan, Josef Sorkin
**Financial:** T. J. Cambern, D. E. Harper
**Registration, Ticket:** Jack F. Daily, Maurice H. Ellis, Rollie G. Fehrman, Donald L. Simcox, Richard O. Davis, Hewitt R. Herdlinger
**Publicity:** A. P. Godley, Henry J. Weinstein
**Arrangements:** Carter Callahan, B. M. Nagle
**Reception:** Sydney C. Davis, Ed M. Newman, J. Q. A. Greene, John N. Newell
**Inspection Trip:** James D. Bucher, Frank E. Bleistein, A. D. Kaufman, H. B. Wright

# FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Many constructive factors will affect the nation's economic future. Orders for steel, industrial supplies, and machinery have turned upward this year. New construction is at a higher level than last year despite the declining emphasis on military construction. Commercial building, school building, and highway construction are expected to be the bright spots that will keep the 1954 total at a high level offsetting possible declines in industrial and military construction. Construction of new modern office buildings is proceeding at a rapid rate in many sections of the country—as a random example, two deluxe buildings are going up in the same block as the ASCE Washington office, the first new construction in the block in a decade.

Other measures relating to public works for use in overcoming a business recession are under consideration. They relate both to funds for the projects and to the government organization for handling such measures. In view of the fact that emergency public-works programs are principally helpful for stimulating a depressed construction industry rather than for remedying unemployment situations that may occur in other industries, the signal for using such measures is not likely to be given in the immediate future.

### Pending Legislation

H.R. 8302 would extend the duration of the Water Pollution Control Act another five years. H.R. 7341 would amend the hospital survey and construction provisions of the Public Health Service Act to include surveys and construction assistance for nursing homes, diagnostic centers, and other types of medical facilities.

Future prospects for highway construction appear very good. The administration bill increasing highway fund allocations by 39 percent for the fiscal years ending in 1956 and 1957, has passed the House. During the recently concluded Senate hearings, Senator Ferguson supported his bill that would allocate the huge sum of $2 2 billion a year for highways—two and one-half times the amount which the Administration bill would authorize.

Of course the tax bill occupies the national spotlight, and its fate may determine the expenditures that will be available for other proposals during the year. No action affecting the Society's interests in labor legislation appears likely for the present.

The new housing bill is receiving attention in both House and Senate committees. It provides for expansion of slum-clearance operations following the President's recommendations. Communities would receive liberal financial aid from the federal government in making over the slum areas, expanding the concept of the present slum clearance program into one of urban rehabilitation. A section on advance planning of public works was included in these bills, H.R. 7839 and S. 2938. Advances would be made in order to set up a reserve of planned public works which could be put under construction as a means of stimulating the economy of the country in the event that this is required.

In connection with this proposal, the Field Representative testified along the lines of a recent resolution of the Board of Direction—that public works should not be considered as mere accessories to public housing and slum clearance and that such planning should be done by specially qualified bureaus and agencies. The Field Representative emphasized the necessity for making complete engineering studies as distinguished from a mere emergency shelf of hurriedly prepared plans that might become obsolete before the project was constructed. In referring to the fact that the President's Committee on Housing Policies had recommended transfer of most of the programs of the present Bureau of Community Facilities to the Department of Health, Education and Welfare, which is also proposed as the agency to handle grants-in-aid for various types of hospitals, nurses homes, etc., it was mentioned that the sanitary engineers in the Public Health Service of this same Department have had important responsibilities in connection with basic planning of sanitary engineering projects. Many defects need to be remedied if advance planning is to be a continued subject of federal grants. The fact that a local body is not required to repay the advance unless the particular project is built, requires that such federal grants be made under the supervision of competent specialists. The engineering profession has an obligation to take the lead in improving the programs. Fearing that the work might be absorbed as a part of slum-clearance and public-housing operations, the National Society of Professional Engineers urged the administration and the Congressional committees to place the program in some other agency than the Housing and Home Finance Agency.

A minimum condition of continuing the work in the HHFA would be (1) sound engineering planning; (2) correlation of projects with the programs of the department responsible for basic planning in the field; (3) separation of the program from housing, housing-finance, and slum-clearance planning; and (4) administration as a major activity reporting directly to the agency head. Carrying out the recommendations of the President's Advisory Committee to transfer much of the community facilities work outside the agency would seem to suggest that advance planning might also be more appropriately handled in another agency.

S. 24, the bill designed to assure judicial review of disputes on contracts has been reported out of the Judiciary Committee and appears headed for final action within a month. Senate hearings were held on the Contract Renegotiation Bill, H.R. 6287. The Chamber of Commerce of the United States appeared in support of the amendment to increase the minimum amount subject to renegotiation, the position previously taken by the Society. Since the expiration of the Act on December 31, the Defense Department has been inserting stop-gap renegotiating clauses in all contracts.

The Committee on Inter-Governmental Relations, until recently headed by Clarence Manion, was given an additional year, until March 1955, to report to the President and Congress. Federal-state relations in the highway field are an important topic under study by this group. The House Appropriations Committee approved an additional $300,000 for expenses of the new Hoover Commission on Government Organization, which is only one-fifth the amount asked by the President. The Appropriations Committee wants a more precise estimate of needs before making further funds available.

Steps are being taken to organize an association of toll-road-operating groups. Toll roads seem destined to play an important roll in highway construction in the immediate future. A Chicago-Miami toll road is one of the most ambitious ideas being discussed.

*Washington, D.C.*
*March 18, 1954*

**ASCE MEMBERSHIP AS OF MARCH 9, 1954**

| | |
|---|---|
| Members | 8,545 |
| Associate Members | 10,948 |
| Junior Members | 17,589 |
| Affiliates | 70 |
| Honorary Members | 42 |
| | 37,192 |
| (March 9, 1953 | 35,975) |

## Lively Program Marks Southeastern Student Conference

The recent two-day Southeastern Student Conference, to which Georgia Institute of Technology was host during the ASCE Atlanta Convention, turned out to be one of the notable Convention features. The culminating event of the conference, which included a program of student papers, talks on career opportunities in the profession, and a dinner dance, was a tour of Southern Railway facilities in the Atlanta area and a luncheon provided through the courtesy of the railroad.

D. W. Brosnan, a former Student Chapter member who is now vice-president in charge of operations for the Southern Railway System, discussed career opportunities with the railroad in a talk that was enthusiastically received by the 250 delegates attending the dinner. Noting that, "While the railroad industry, is old, it is ever new," Mr. Brosnan remarked that it is one of the largest employers of engineering talent. "In my own company for example," he said, "we have upwards of 300 engineers . . . . Almost the entire management of Southern Railway possesses an engineering background, and as far as we can see this condition will be true indefinitely. . . .

"Our uses for engineers," said Mr. Brosnan, "may be roughly divided into two large groups. The first relates purely to engineering . . . , plus the myriad variations which stem from engineering functions in exploring mutual problems with other railraods, other companies, and the various government agencies, such as city and state . . . . The second group, the one which in my judgment offers the greatest challenge, the greatest opportunity for engineering brains, is that of management." Citing the many administrative posts filled by engineers in his own company, Mr. Brosnan said, "To fill these places, the engineer is best qualified, and particularly the civil engineer." In concluding, he pointed out that "the railroads are still frontiers—frontiers challenging the mind of man and his ingenuity."

Other authorities heard during the two-day program were Francis M. Dawson, Director of the Society and dean of the College of Engineering at the University of Iowa, whose subject was "Intangibles in Engineering," and L. W. Robert, Jr., Atlanta consultant, who spoke on "World-Wide Opportunities for Engineers."

A wide range of research work and observation was represented in the interesting student papers presented. Authors and their subjects were Sidney E. Hawkins, president of the Georgia Tech Student Chapter, who discussed "The Treatment of Sulfite Wastes in the Wood Pulp Industry"; Cadet Edgar Bare, president of the VMI Student Chapter, whose subject was "Lexington, Va., Builds a Limited Access Distribution Road"; Harold Wahking, of the University of Louisville, whose paper was entitled, "Desire—the Mother of the Architectural Profession"; H. Peter Goodling, of the University of Florida, who wrote on the topic, "Should the Adviser or the Student Receive Credit and Recognition for Graduate Work?"; L. E. Pendergrast, of the University of Tennessee, who reported on a project for supplying water for navigation on a stretch of the St. Francis River identified as the "Marked Tree Siphon"; and Cadet R. A. Hubbard, of VMI, who wrote on "How Cost Cutting and Lack of Planning Necessitated a Complete Change in a Municipality's Sewage and Drainage System."

Delegates to Southeastern Student Conference on tour of the facilities of the Southern Railway System watch a diesel engine being hoisted from its tracks by a giant overhead crane in the locomotive shop. The group below (front row) shows Edgar Bare, president of the VMI Chapter; Sidney E. Hawkins, president of Georgia Tech Chapter; ASCE President Daniel V. Terrell; and ASCE Director Francis M. Dawson, dean of engineering at the University of Iowa. In back row are Blake R. Van Leer, president of Georgia Tech; Ray Chalfant, Faculty Adviser at Georgia Tech; and Col. Paul C. Brown, Atlanta, a conference speaker.

## Price of Separates Folder Increased

An increase of 75 cents in the price of the new-type fabrikoid folders used for binding Proceedings-Separates is necessitated. From now on the folders will be $3.00 instead of $2.25. Since most of the Proceedings-Separates will not be reprinted in TRANSACTIONS, there is special point in binding the Separates. The new-type folders will easily accommodate up to thirty Separates.

## Power Study Featured at Pacific Northwest Conference

The industrial and power potential of the Inland Empire of Eastern Washington and Northern Idaho will be demonstrated to visitors when the Sixth Annual Pacific Northwest Conference of Local Sections meets in Spokane on April 23 and 24. Instead of the usual fare of technical papers, the host Section (Spokane) is scheduling a "Power and Industry Symposium" for Friday afternoon, April 23, in which authorities on the basic industries of the Spokane area will present the economic background of the rapidly growing region. Topics will include power development, the agricultural, mining, light metals and timber industries, with the role played by the engineer.

Saturday, April 24, will be a day for field trips and first-hand study of power and industry. Visitors will choose between two trips: One along the shores of Pend Oreille Lake, by the new Albeni Falls Dam and Reservoir to the new Cabinet Gorge hydroelectric development; the other to inspect spectacular industrial developments near Spokane, including the Fairchild Air Force Base and Kaiser's huge aluminum reduction plant and rolling mill. Both field trips will come together for a beach barbecue on Lake Coeur d'Alene.

A Friday night banquet will be a conference highlight, with the principal address delivered by Dr. William A. Pearl, newly appointed Bonneville Power Administrator. Dr. Pearl will speak on "The Effect of Power on Industrial Development."

Visiting ladies will be entertained by the Ladies' Auxiliary of the Spokane Section. Special events planned for them include a luncheon and a sightseeing trip

A business session of conference officers and official delegates, at which new officers will be elected, will meet April 23. Prof. Fred H. Rhodes, of the University of Washington, Seattle, is conference chairman, H. J. Doolittle, of Spokane, vice-chairman, and H. K. Johnson, of Seattle, secretary-treasurer. General chairman of arrangements for the Host Section is T. H. Judd. Other chairmen are J. P. Esvelt, program; R. E. Tobin, finance; E. B. Moore, reception; E. L. Haines, registration and housing; L. B. Almy, student activities; and W. E. Williams, publicity.

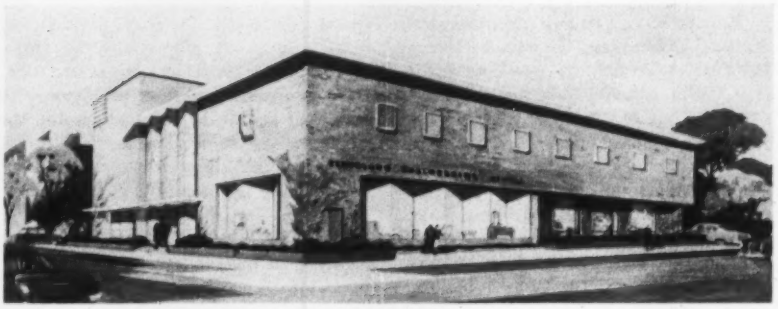
## Scheduled ASCE Conventions

**ATLANTIC CITY CONVENTION**
Atlantic City, N.J.
Chalfonte-Haddon Hall
June 14–19, 1954

**NEW YORK CONVENTION**
New York, N.Y.
Hotel Statler
October 18–22
1954

**SAN DIEGO CONVENTION**
San Diego, Calif.
Hotel U. S. Grant
February 6–11, 1955

## *Cleveland to Have New Engineering Center*



**A new downtown Engineering Center, planned by the Cleveland Engineering Society and shown here in artist's sketch, will be a focal point for all engineering activities in northeastern Ohio. To be known as the Cleveland Engineering Center, the two-story structure will provide some 36,000 sq ft of space including an auditorium seating 950 and dining room facilities for 400. The building, which will cost about $1,378,000, will be completed in time for celebration of the Cleveland Engineering Society's 75th anniversary. The Cleveland Section of ASCE is one of the local groups making up the Cleveland Engineering Society, which has a membership of more than 2,000.**

# NOTES FROM THE LOCAL SECTIONS

*(Copy for these columns must be received by the tenth of the month preceding date of publication.)*

Featured speaker at the **Akron Section's** February dinner meeting was ASCE Director Warren W. Parks, who talked on the make-up of the Society at both District and national level. New Section officers, elected at the January meeting, are Howard F. Miller, president; Charles E. Cockerham, vice-president; and William R. Ruhlin, secretary-treasurer.

Members of the **Brazil Section** are enjoying a lively program of monthly meetings preceded by inspection tours. Recently trips have been made to the "Usina Siderurgica de Volta Redonda," the largest steel mill in Latin America with an annual production of 500,000 tons; the Piratininga Steam Plant, which is being built by the Stone & Webster Engineering Corp. for the São Paulo Light & Power Co.; and the Pedreira Pumping Plant, another São Paulo electric power installation. The Section is planning to assist "foreign ASCE colleagues" attending the international conferences slated for Rio de Janeiro and São Paulo this summer.

The technical program for the **Buffalo Section's** February luncheon meeting consisted of the showing of an International Harvester Co. film called "Man with a Thousand Hands." The film tells the story of man's battle with nature in constructing the Kitimat Power Project in British Columbia.

The **Central Ohio Section** has asked its executive committee to act with other local engineering groups on its behalf in trying to solve the problem of unionization of engineers. Unionization developments among engineers working on the Ohio Turnpike were discussed at a recent meeting by Charles P. Smith, executive assistant to the Ohio Turnpike Commission.

Sanitary engineering, past and present, was discussed at the February 19 meeting of the **Cleveland Section,** by L. W. Weinberger, assistant professor of civil and sanitary engineering at Case Institute of Technology. Mr. Weinberger also covered the various fields open to and needing properly qualified sanitary engineers. During the meeting it was announced that the Section will be host to a Society Convention in May 1957.

New **Columbia Section** officers, installed at the January meeting in Walla Walla, Wash., are Melvin B. Nelson, president; Myron H. Russ and Glenn H. Von Gunten, first and second vice-presidents; and A. E. Engler, secretary-treasurer. In a talk on Pacific Northwest power problems, M. F. Hatch, engineer for the Washington Water

Power Co., attributed the growing power shortage in the Northwest to the "complexity of the problems involved in the development of natural resources and lack of direct responsibility upon the part of any one group for solution of the problems."

Officers and directors of the **Illinois Section** announce a campaign to step up the service of the Section to its members by increasing the number of mailings to members and by lining up especially interesting programs for the weekly luncheon and occasional evening meetings. The program committee, headed by Linas Brown, reports the gratifying attendance of about 60 at recent luncheons. E. Montford Fucik is president of the Section.

Use of the Wellpoint System for unwatering foundations and other excavations was described by R. Y. Bush, of the John Stang Wellpoint Co., in the leading talk at the February 18 meeting of the **Intermountain Section.**

The importance of good understanding of the principles of hydraulics to the successful design of large culverts was emphasized in an illustrated talk on "Design of Highway Culverts on Steep Slopes" given at the **Iowa Section's** February meeting. Harry James assistant engineer for the Iowa Highway Commission, was featured speaker.

The **Ithaca Section** had a joint meeting with the Cornell University Student Chapter in February to hear M. D. Morris, engineer for Soiltest, Inc., New York, speak on the construction of the Orinoco Mining Company's Cerro Bolivar Project. At a Section dinner preceding the joint session Prof. Carl Crandall reviewed pending legislation regarding the practice of professional engineering in corporations and suggested that Section members take individual action in the matter as they see fit.

A new mathematical system under development at the Midwest Research Institute of Kansas City was described at the **Kansas City Section's** February meeting by Martin Goland, associate director of the Institute. The system, which Mr. Goland termed "Operations Research," was broadly defined as the use of technical methods for solution of non-technical problems. It uses as tools probabilities and statistics, calculus, and linear programming. George Bradshaw, professor of civil engineering at the University of Kansas, announced a new program of graduate study that will be available this summer to local civil engineers wishing to earn a master's degree. Thirty credit hours of study must be completed.

February 26 was Ladies' Night for wives of members of the **Kansas Section,** the Wichita Society of Professional Engineers and the Wichita Engineers Club, which had a joint meeting at Wichita with distaff members of the household as guests. A number of engineering students from Wichita University were also present. Featured speaker was Lyle Parmely, project engineer for Boeing Aircraft, and his subject, "Comparison of Automotive and Aircraft Engineering."

Engineering problems encountered in extension of the Maine Turnpike were discussed at a meeting of the **Maine Section** in Portland on February 10. Featured speaker, James P. Exum, engineer in charge of construction of the project for Howard, Needles, Tammen & Bergendoff, described the alternate routes around Portland that were studied in order to avoid areas of deep marine clay and explained the "toe-loading" method that was finally adopted for use in the unstable soil.

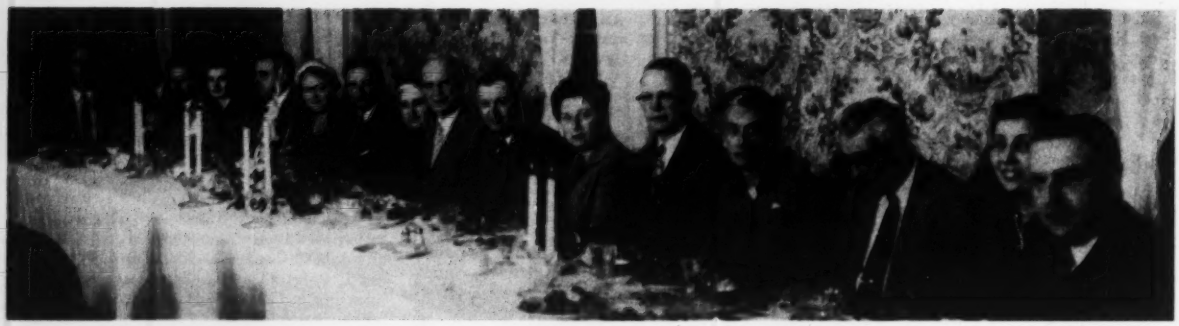
ASCE President Daniel Terrell, Director George W. McAlpin, and Field Representative Joseph Ehlers were guests of the **Maryland Section** for its February 10 meeting in Baltimore. In a résumé of current Board action, Dean Terrell stressed the importance of the Junior Members, who now represent 47 percent of the total Society membership. Mr. McAlpin praised the intensive work done by the Local Sections in the formation of the District 6 Council, and Mr. Ehlers commented on engineering legislation now pending in Congress. The Capital Improvement Program was discussed at the January meeting by Thomas F. Hubbard, chairman of the Baltimore City Planning Commission, and Paul L. Holland, director of the Baltimore Department of Public Works.

A new **Metropolitan Section** activity got under way in February when the recently formed Sanitary Engineering Group held its first meeting. There was a turnout of about 75 to hear two engineers with the New York City Department of Sanitation—C. A. Rogus, director of engineering, and Maurice Feldman, civil sanitary engineer—speak on sanitary landfills that are being used in New York as a method of refuse disposal pending completion of the city's incinerator program. Mario Salvadori, professor of civil engineering at Columbia University, was featured speaker at the Section's regular February meeting with a talk entitled "Structural Imagination—the Design and Construction of Thin Shells."

In lieu of its March meeting, the **Miami Section** was one of the sponsoring groups for an Engineers' Week Banquet held at the University of Miami. J. H. Clouse, dean of the College of Engineering at the university, was honored as "Engineer of the Year." An audience of 300, representing the seven professional societies involved, heard Everett S. Lee, past-president of

Board of Directors of Arizona Section meets to plan the first of the large quarterly meetings that will initiate a new Section policy of more meetings. Shown here, left to right, are Hanen H. Williams, first vice-president; Dario Travaini, president; and Wilbur L. Heckler, secretary-treasurer. Standing are H. C. Schwalen, immediate past-president, and E. J. Maggi, second vice-president. Mr. Maggi is editor of the Section's flourishing newsletter.

ASCE President Daniel V. Terrell is guest of honor and principal speaker at annual joint luncheon of the Kentucky Section and the Kentucky Society of Professional Engineers in Lexington. Pictured here (in usual order) are G. Reynolds Watkins, vice-president of Kentucky Section and president of Kentucky Society of Professional Engineers; A. O. Neiser, vice-president of KSPE; President Terrell; and John H. Clark, III, president of Kentucky Section.



Speakers table at recent annual meeting of the Michigan Section shows, left to right, Charles A. Miller, Section director; Lloyd T. Cheney, secretary-treasurer; Mrs. Cheney; Fred H. Burley, second vice-president; Mrs. Wood; Benson J. Wood, Section president; Mrs. Newton; Dudley Newton, past-president of Section; Lloyd D. Knapp, ASCE Director for District 7; Mrs. Ling, Prof. Daniel S. Ling, of Wayne University; Mrs. Weber; Carlos A. Weber, Section director; Mrs. Finney; and Edwin A. Finney, retiring Section president. The meeting, which was one of the largest in recent years with over 100 in attendance, featured installation of new officers and talks by Director Knapp and Professor Ling. Mr. Knapp discussed Society affairs, and Professor Ling a trip through our national parks.

AIEE and a member of the General Electric staff, speak on "What Is New in Science and Engineering." ASCE President Daniel V. Terrell was guest of honor and speaker at another recent meeting.

Fluoridation of public water supplies was discussed by H. A. Kroeze, engineer with the Mississippi State Board of Health, at a recent meeting of the **Jackson Branch** of the **Mid-South Section.** S. W. Chandler reported on the recent organizational meeting of the District 14 Council in St. Louis and gave the Branch a copy of the constitution of the Council for study. The program for a recent dinner meeting of the **Little Rock Branch** consisted of the presentation of a film showing the entire steel-making process. The film was shown and explained by Harry Gray, Jr., district manager for the Sheffield Steel Corp.

Four Student Chapter members from Vanderbilt University were guests of the **Nashville Section** at its February meeting as winners of four Section prizes of $10 for the best papers. Orville Wheeler read his paper on modern architecture, and Henry Derthick his on industrial waste disposal. The other winners—Dick Griffith and George E. Wilkins—will read their papers (on the Pennsylvania Turnpike and plywood, respectively) at a later meeting. ASCE Director James A. Higgs was featured speaker with a talk entitled "The Meaning of Membership in ASCE."

To the growing list of Section newsletters is added Vol. I, No. 1 of "The Nebraska Civil Engineer," a thoughtful and well-edited publication of the **Nebraska Section.** Planned for monthly issue, the four-page periodical with special insert for last-minute news "culminates long-standing hopes and plans of the officers" to bridge the gap between members in the Section's tremendous area. Some sixteen members spotted throughout the state have been appointed to serve on a Publications Committee and collect news.

Minnesota water problems—including the state water law, the Governor's Interim Commission for Water Resources, pollution problems, ground-water problems, and problems in fish and game management—were discussed in a series of eight-minute talks making up the program for the **Northwestern Section's** February meeting. The experts were S. A. Frellson, director, Division of Waters, Minnesota Department of Sanitation; F. J. Magnuson, city engineer, North Mankato; Harvey Rogers, director, Division of Water Pollution Control, State Board of Health; George Schwartz, state geologist; and Tom Schrader, regional supervisor, River Basin Studies, U.S. Fish and Wildlife Service. The March program consisted of talks on the construction and use of electronic computers given by Fred Lang, of Engineering Research Associates, and Al Young, of Remington Rand.

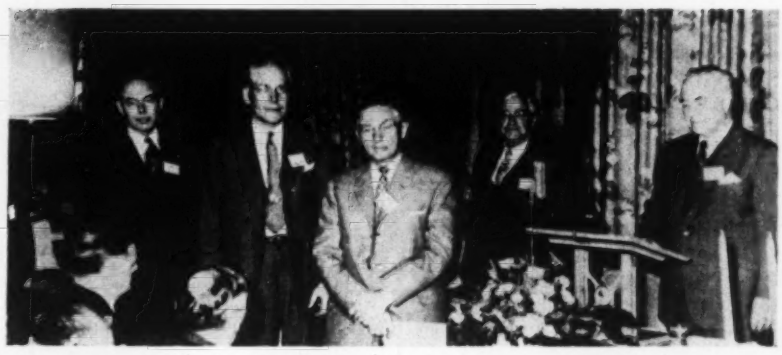
In a talk entitled "What Price Parking," William A. Bowes, city commissioner of Portland, described a recent trip to nine cities for the purpose of studying parking problems at the February 11 meeting of the **Oregon Section.** Mr. Bowes suggested possible solutions and their effect on business.

Braving icy temperatures, 32 hardy members of the **Philadelphia Section** (chiefly Junior Members) and members of the Drexel Institute Student Chapter were on hand for the annual field trip sponsored by the Junior Forum. This year the trip was to the site of the new building under construction for the *Bulletin*. The tour was conducted by Howard Clunn, assistant superintendent for the Turner Construction Co., through arrangements made by Field Trip Chairman Edward Byrkit. The project, consisting of a garage, press building, stereotype building, office building, and parking plaza, incorporates a great variety of structural framing systems—concrete joist, slab band, flat slab, flat plate, structural steel, and long-span joist.

Col. R. A. Lincoln, district engineer for the Corps of Engineers at Pittsburgh, was featured speaker at a recent joint meeting of the **Pittsburgh Section** and the Engineers Society of Western Pennsylvania. His subject was "Engineering Planning for Military Operations in Korea." The Junior Branch held a meeting on February 16, with R. P. Brown, personnel director for the Mesta Machine Co., the principal speaker.

The design of the projected Mackinac Straits Bridge was described at a recent meeting of the **Providence Section** by C. H. Gronquist, associate engineer for D. B. Steinman, New York consultant and designer of the structure. The talk dealt particularly with the foundation problems involved. Section officers commented on the increasingly "cordial relations among Section members," resulting from a new policy of pre-meeting dinners.

Engineers had the last word in a panel discussion of water rights and water law in California given by both lawyers and engineers at the February meeting of the **Sacramento Section's Central Valley Subsection.** Martin McDonough, Sacramento water rights attorney, headed up discussion for the lawyers, and W. R. Gianelli, engineer for the State Division of Water Resources, for the engineers. Riparian rights, prescription rights, and court actions were discussed by Mr. McDonough, while Mr. Gianelli outlined the method of obtaining water rights by appropriations under California state law.



New life members of the Pittsburgh Section receive their certificates at the Section's annual meeting and banquet. Standing, in usual order, are H. Malcolm Priest, John F. Laboon, and C. J. Jacobsen. In the background are President Terrell and William A. Conwell, Pittsburgh Section president. New life members unable to attend the meeting are Paul A. Daniells and Nathan B. Jacobs. The presentations were made by President Terrell, who spoke on increased Society service.

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The **South Carolina Section's** annual winter meeting, held in Columbia on January 22, consisted of two technical sessions, a business meeting, luncheon, and dinner. Speakers included Robert T. Wakeman, chief, Propagation Section, Allen B. Dumont Laboratories, Passaic, N.J., whose subject was "Status of Color Television and UHF"; J. L. Weeks, general supervisor of safety, South Carolina Electric & Gas Co., who discussed "Safety in People"; and C. E. Busby, soil conservationist, U.S. Soil Conservation Service, Berkeley, Calif., who spoke on "Appropriation Rights of Water." During the business meeting Harry M. Mims was elected president of the Section. I. A. Trively, vice-president, and Albert E. Johnson, secretary-treasurer, were elected last year for two-year terms. The Section voted to contribute $50 to each Student Chapter in the state to help defray the expense of sending delegates to the Atlanta Convention.

Telephone communication between any two points in the United States without operator assistance will probably be possible in the not-too-distant future, members of the **Syracuse Section** were told in the featured talk at a recent joint meeting with the Technology Club of Syracuse. Morley P. Reed, district traffic engineer for the New York Telephone Co., was the speaker.

The dos and don'ts of preparing income tax returns properly were recounted for the benefit of members attending the February meeting of the **San Antonio Branch** of the **Texas Section.** The timely lecture was delivered by R. S. Walker of the Bureau of Internal Revenue. R. M. Dixon, managing director of the Municipal Contractors' Association, addressed the February meeting of the Fort Worth Branch on "Contractor-Engineer Relations."

Problems involved in design and construction of the new airport terminal building at Moline, Ill., were discussed at a recent meeting of the **Tri-City Section.** Chris Maiwald, of Swanson & Maiwald, local engineering-architectural firm, was the principal speaker.

Human qualities that engineers need in the role of manager, which they are increasingly called upon to fill, were discussed at the **West Virginia Section's** February meeting by George Thom, assistant employee relations superintendent for the E. I. Dupont de Nemours Co. at its Belle, W.Va., plant. The attributes that Mr. Thom listed are high tolerance to frustration; social perceptiveness; appreciation of teamwork; objectivity; and a sense of security. These can be built into character just as the engineer builds power, strength, and flexibility into his structures, he said.

## Coming Events

**Central Illinois**—Evening meeting at the University Men's Club, Urbana, April 13, to be addressed by ASCE President D. V. Terrell.

**Central Ohio**—Meeting at Athens, Ohio, April 29, with the Ohio University Student Chapter as host.

**Connecticut**—Meeting in Hartford, April 14, featuring a talk on the Hartford-Statler by William B. Tabler, architect.

**Los Angeles**—Tour of laboratories of the California Institute of Technology, April 14, from 4:30 to 5:30 p.m. followed by dinner at the Athenaeum, South Hill Ave. and California St., and talk in Arms Hall, 7:30 p.m. Junior Forum will hold a banquet at Rudi's Italian Inn, 3773 Crenshaw Boulevard, April 23, 6 p.m. Santa Barbara-Ventura County Branch will meet at the Palm Hotel, Carpinteria, April 14, 6:30 p.m.

**Maine**—Spring conference scheduled to meet at the University of Maine, May 5.

**Metropolitan**—Meeting in the auditorium of the Engineering Societies Building, New York, N.Y., April 21, 7 p.m. Meetings of the Junior Branch, in the ASCE Board Room, April 14 and 28, 7:30 p.m.

**Mid-South**—Spring meeting at the Hotel Claridge, Memphis, Tenn., April 23.

**Northeastern**—Joint meeting with Boston Society of Civil Engineers at the Boston City Club, April 13.

**Pacific Northwest Conference.** Two-day meeting at the Davenport Hotel, Spokane, Wash., April 23–24, featuring a technical symposium on "Power and Industry in the Northwest" and field trips to Cabinet Gorge Dam, Fairchild Air Base, and aluminum industries in Spokane.

**Pacific Southwest Conference**—Seventh Annual Pacific Southwest Conference at the Senator Hotel, Sacramento, Calif., April 28–May 1. Official participants will be the Arizona, Hawaii, Intermountain, Los Angeles, Oregon, Sacramento, San Diego and San Francisco Sections, as well as all Subsections and Student Chapters for these areas.

**Spokane**—Business meeting preceding the Pacific Northwest Conference at the Hotel Davenport, April 9.

**Tennessee Valley**—Annual spring meeting at Muscle Shoals, Ala., May 14 and 15, featuring business and technical sessions followed by dinner at the Tuscumbia County Club on Friday and tour of a local plant on Saturday. Headquarters for the secretary will be the Muscle Shoals Hotel in Sheffield, Ala.

**Texas**—Spring meeting to be held at the Hotel Scharbauer, Midland, Tex., April 9 and 10. Soil mechanics, water resources, and sanitary engineering sessions, beginning Friday morning, April 9, in addition to the Construction Division's First Pipeline Conference (see March issue, page 79). Requests for reservations should be made to V. E. Young, P.O. Box 1600, Midland, Tex.

**Virginia**—Joint meeting with the Annual Conference of ASCE Student Chapters in Virginia, to be held at Virginia Polytechnic Institute, April 26. The program will feature a student paper competition.

**Wisconsin**—Ladies' Night at Boulevard Inn (4300 W. Lloyd St.), Milwaukee, April 22. Dinner at 8, preceded by cocktail hour.

# NEWS BRIEFS . . .

## Auto Toll Tunnel Under Continental Divide Voted

Construction of a vehicular tunnel through the Continental Divide was recently voted by the Colorado Legislature. The governor has signed the measure, which authorizes the Colorado State Highway Department to issue $16,000,000 in bonds to finance the project. Aside from stipulating that the tunnel be connected with U.S. Highways 6 and 40, the legislature made no recommendations as to where or when it should be built.

In a joint report recently completed for the Department of Highways, the engineering firms of Howard, Needles, Tammen & Bergendoff and Singstad & Baillie recommend a tunnel running a mile and a half through the Rockies at Straight Creek, about 60 miles west of Denver. The report states that the Straight Creek tunnel route would cost less than any other suitable route, that it would be free from serious snowslides, and that it would meet the legislative requirement of serving U.S. Routes 6 and 40. According to traffic surveys, it would attract a greater volume of traffic than any other route, and would consequently have the greatest earning capacity as a toll project.

The Straight Creek Tunnel would be 7,170 ft long between rock portals and 24 ft wide between curbs, with a clear height of 14 ft $4^3/_4$ in. to tunnel ceiling. It is to be lined with reinforced concrete, which will have a minimum thickness of 12 in. where the rock is sound and self supporting. Where necessary, steel posts, arch ribs, and lagging will be used to support the excavation during construction, and for such locations the lining will have a minimum thickness of 23 in. The lining is not designed for hydrostatic pressures because provision has been made for free drainage at the portals. The roadway will be paved with concrete.

Roadway elevation is 11,237 ft at the east portal and 11,278 ft at the west portal. The Continental Divide rises to an elevation of 12,500 ft over the tunnel, a maximum cover of approximately 1,200 ft. The present highway at Loveland Pass crosses the Continental Divide at an elevation of 11,992 ft.

Total cost of the Straight Creek tunnel is placed at $12,850,000, and the time required for construction is estimated at 30 months. The cost of a tunnel at Loveland Pass, the only other route of the four surveyed that was considered possible would be $13,982,000, and 36 months would be required for construction.

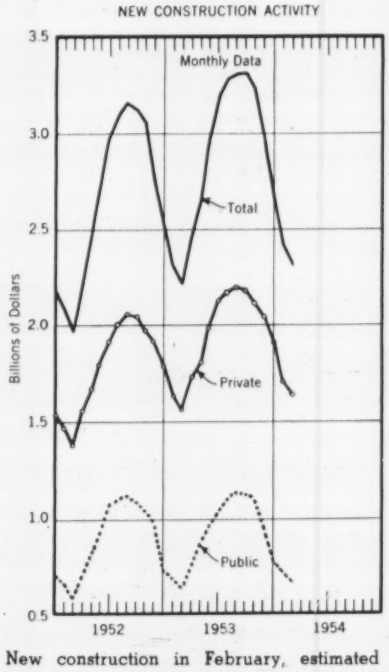
## Spending for Construction at Record February High

February expenditures for new construction declined less than seasonally to $2.3 billion, and were at a record high for the month, according to preliminary estimates of the Bureau of Labor Statistics of the U.S. Department of Labor and the Department of Commerce's Building Materials and Construction Division. Total outlays were at an annual rate of well over $36 billion, after allowance for seasonal factors.

Private residential building, highway construction, and most types of private nonresidential building showed less-than-seasonal declines during February, while construction of public school, hospital, and sewer and water facilities rose contraseasonally. Decreases last month were about seasonal for privately owned public utilities, but more than usual for stores, military installations, and conservation and development work.

During the first two months of this year, expenditures for all new construction totaled $4.75 million, 2 percent more than the 1953 January-February total. A shift had occurred since 1953 in the various types of construction under way. For example, a major downswing of 35 percent on military facilities (resulting largely from decreases in troop housing and warehousing) was more than offset by an increase of nearly 50 percent in commercial building.

Recreational building was also up for the first two months, by 50 percent, while educational (private and public) and religious building were about 20 percent higher. Utilities, and sewer and water facilities construction were up by more than 10 percent, roadbuilding was moderately higher, and new private residential building maintained a slight edge over 1953. On the other hand, hospital building was down from 1953 almost entirely because of a 34-percent decline in public hospital construction. In addition, conservation and development construction (reflecting the effect of reduced appropriations), private industrial building, public housing, and farm construction were substantially lower this year than last, when the first two months are compared.




New construction in February, estimated at $2.3 billion, remained at unseasonal high for the month, as shown in Department of Commerce curves.

Thus far in 1954, expenditures for all types of new construction total $3.36 billion—5 percent above last year's total for the same period. Outlays for new public construction, at $1.39 billion, trailed the 1953 figure by 4 percent.

## Engines Chosen for Miami Sewage Treatment Plant

The City of Miami, Fla., has ordered five Worthington dual-fuel engines for use in the $24,000,000 sewage-treatment plant being built to keep its beaches free from contamination. One of the engines—a seven-cylinder 480-hp machine—will drive a generator to supply electric power to the plant. Four six-cylinder 410-hp engines will drive the blowers to activate the sludge beds. The engines will be fueled by the gas generated from the digested sludge after aeration. The dual-fuel arrangement permits changing over from gas to oil, or any combination of the two, as may be required.

The plant is located on Virginia Key in Biscayne Bay, and the effluent will be discharged into the sea after treatment. Designs for the plant were drawn up by Metcalf & Eddy, of Boston.

# ACI Celebrates Its Golden Anniversary with Large Denver Meeting

The American Concrete Institute celebrated its golden anniversary during an unusually well attended annual convention, held in Denver, Colo., February 22–26. In his presidential swan song Henry L. Kennedy, M. ASCE, reviewed the 50-year growth of ACI to its present membership of over 6,000, with representatives in 70 foreign countries, and characterized the institute as "the foremost of its kind in the world." He handed the gavel to President-elect Charles H. Scholer, M. ASCE, head of the Department of Applied Mechanics at Kansas State College. Other new officers installed were Frank Kerekes, M. ASCE, assistant dean of engineering at Iowa State College, who became vice-president for a two-year term, and four directors who took office for three-year terms. The new directors are Phil M. Ferguson, M. ASCE, chairman of the Department of Civil Engineering at the University of Texas; Rear-Admiral Joseph H. Jelley, M. ASCE, Director of Construction in the Department of Defense, Washington, D.C.; H. C. Ross, assistant director of research for the Hydroelectric Power Commission of Ontario, Canada; and George W. Washa, professor of mechanics, University of Washington.

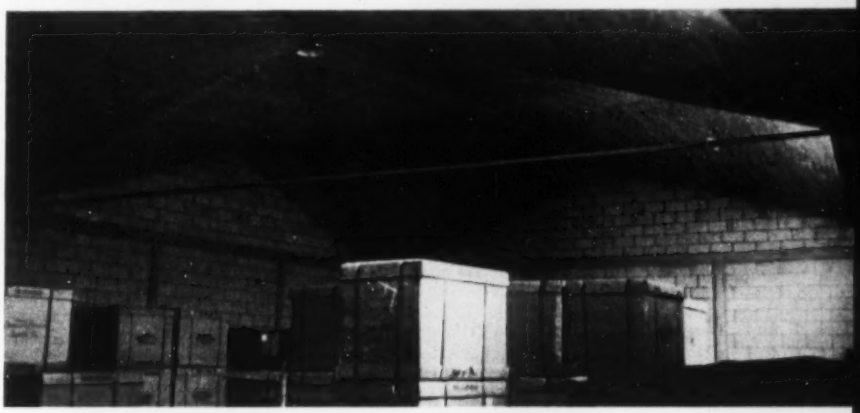
### Busy Year Predicted

A busy year for designers and builders of concrete structures was predicted in the technical sessions. Norman P. Mason, chairman of the Construction and Civic Development Department of the Chamber of Commerce of the United States, estimated that the total volume of new construction in 1954 will be within 7 or 8 percent of the 1953 total, or about $34 billion—two-thirds in private funds, one-third in public funds.

In the opinion of Admiral Jelley, the year will be marked by keener competition between various construction materials. In the field of concrete, he said, the tremendous potential of techniques of precasting and prestressing are yet to be realized. Although concrete is often sold on the basis of low cost and long life, only with adequate cost data can it be proved in a competitive market that concrete will save money over the life of the facility. He warned that only through good construction practices can the building industry obtain the fullest benefit from research taking place and improved designs being developed in the concrete field.

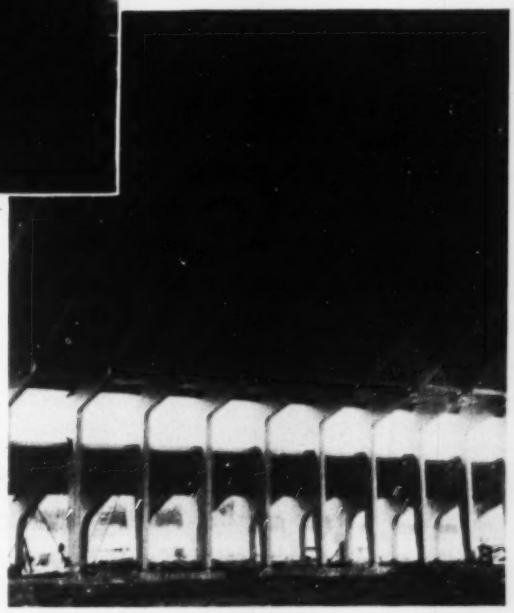
Maj. Gen. Samuel D. Sturgis, Chief of Engineers, U.S. Army, announced a new administrative approach to the government's construction of multi-purpose dams—a partnership policy by means of which a community or a utility contributes toward the cost of such a dam so that it can later share in the water from the reservoir for domestic supply and own the power plant and the electric energy developed. He highlighted the Corps' extensive use of concrete, especially for airbase runways, which are now 44 percent concrete on a yardage basis, and 65 percent concrete on a cost basis. "Cost is the biggest challenge which the concrete industry has to meet," he said.

A large user of concrete is the U.S Bureau of Reclamation. Reclamation Commissioner W. A. Dexheimer, M. ASCE, pointed out that the ACI and the USBR are of the same generation. The Bureau's first dam—Roosevelt Dam on the Salt River in Arizona—was built, he said, as Richard L. Humphrey, first president of ACI, was leading that organization toward future heights. Since then great technical progress in the use of concrete has been made by the Bureau, but there is as much



Eight hyperbolic paraboloidal domes, 35 by 40 ft, are used in pairs to form the roof of a textile factory (above) built in Mexico City in 1953. Concrete shell thickness is $1\frac{1}{2}$ in. reinforced with $\frac{1}{4}$-in. round bars 8 in. on centers each way.

For column footings for new Mexico City Custom House (left) which was constructed on soft ground, designer utilized hyperbolic paraboloidal dome-type construction, by inverting the 6-in. concrete slab units so that each slab supports a column.



Inside view of 160-ft concrete hangar built for the Royal Canadian Air Force is shown at the right. The structure was designed for speedy, easy disassembly so that it can be moved and re-erected in a new location.

**Henry L. Kennedy, M. ASCE (left), outgoing president of ACI, congratulates Charles H. Scholer, M. ASCE, his successor in office, during organization's fiftieth annual convention.**

further to go, he said. Investigation of erosion and cavitation, the behavior of mass concrete in dams, development of sulphate-resisting cements, the use of air-entraining agents, selection of alkali-resisting aggregates, and close inspection of work let under competitive bids are a few of the procedures that have saved taxpayers many times the cost of the researches, Mr. Dexheimer noted.

### New Uses for Concrete

Flat plates, thin shells, precast slabs, and prestressed elements of concrete construction came in for much discussion in carefully prepared papers by acknowledged experts from Canada and Mexico as well as the United States. Milo Ketchum, Jr., A.M. ASCE, described his design and the construction of a novel folded-flat-plate roof structure for a Denver concrete-equipment firm's showroom and shop. An area of an acre is roofed with 80-ft clear span folded plates 6 in. thick, which carry 15-ton cranes. Bengt F. Friberg, A.M. ASCE, presented the theory, test, and development of a one-way reinforced concrete slab-floor construction, in which high-strength, galvanized corrugated steel is used for both forms and reinforcement. Mr. Friberg pointed out that wooden forms constitute a major part of the cost of conventional slabs. Corrugated steel forms, remaining in place, serve as reinforcing, require but little intermediate support during pouring, and possibly can serve as the ceiling surface. A major application of this method is in the 20-story steel-frame Denver Club building in Denver, now under construction.

In Canada, Otto Safir of Vancouver, designed and recently completed a 130-ft clear-span precast concrete hangar, 160 ft long, for the Royal Canadian Air Force. An unusual requirement was that the whole hangar be designed so that it could be disassembled, moved, and reerected at a new location in the cold weather. Mr. Safir's solution was a series of three-hinged arches, spaced 10 ft apart, each spanning 110 ft with an 18-ft rise, and springing from the ends of cantilevers projecting inward from the tops of vertical columns, which in turn are stiffened by precast "lean-to" members. A complete arch rib and bent consists of two 6-ton arch ribs, two 7-ton vertical cantilever columns, and two 11-ton "lean-to" supports for the columns. Precast planks 18 in. wide, spanning the 10 ft between the ribs, form the roof. Standard 12-ton motor cranes were used for erection. The completed structure cost $5 per sq ft of covered area.

What is a hyperbolic paraboloid and how can its properties be applied to thin concrete slabs? Felix Candela, architect and engineer of Mexico City, who has recently built a dozen structures in Mexico City, explained the simple theory of bus-stop shelters, cantilevered canopies, factory roofs and foundations. A roof slab rests on one column, not unlike a four-ribbed umbrella turned wrong side out by a gust of wind. For a textile factory Mr. Candela disposed eight hyperbolic paraboloidal domes, 35 by 40 ft in plan, in pairs to form the roof. Concrete shell thickness is $1^1/_2$ in. reinforced with $^1/_4$-in. round mild steel bars 8 in. on centers each way. Form work is simple because the moving element which generates the curved surface is a straight line. Finding this type of construction—a thin slab unit supported by one column—both pleasing to the eye and low in cost, Mr. Candela inverted the unit for the foundation of the new Custom House in Mexico City. A 6-in. umbrella slab forms a footing on soft ground for support of the columns of the building.

### Standards Adopted

The convention unanimously adopted two standards—one on "Specifications for Design and Construction of Reinforced Concrete Chimneys," by Committee 505, and the other on "Recommended Practice for Selecting Proportions for Concrete," by Committee 613. E. A. Dockstader, M. ASCE, is chairman of Committee 505, and Walter H. Price, M. ASCE, chairman of Committee 613.

### Awards and Honors

Presentation of special awards for meritorious papers published by the Institute was another feature of the convention program. The Construction Practice Award—established to recognize the engineer on the job for his resourcefulness in translating design into completed structure—went to Alden M. Klein and J. H. A. Crockett for their paper, "Design and Construction of a Fully Vibration-Controlled Forging Hammer Foundation." An article based on this paper, first presented at a joint ACI-ASCE session during the ASCE Centennial Convention in Chicago in September 1952, also appeared in the January 1953 issue of CIVIL ENGINEERING. David Watstein, of the U.S. Bureau of Standards, received the Wason Medal for the most meritorious paper in the ACI Proceedings, and Phil M. Ferguson, M. ASCE, and J. Neils Thompson, both of the Civil Engineering Department at the University of Texas, were awarded the Wason Medal for notable research. Elected to honorary membership was Raymond E. Davis, M. ASCE, director emeritus of the Engineering Materials Laboratory at the University of California.

L. N. McClellan, M.ASCE, assistant commissioner and chief engineer of the Bureau of Reclamation, was host to the convention at the Denver Federal Center Laboratories, where an open session of ACI Committee 115 on Research was followed by a buffalo barbecue and inspection of the Bureau laboratories.

## Houston Ground-Water Level Is Declining

Continued decline of artesian pressure in wells in the Houston, Tex., area during 1951 and 1952, resulting from additional wells and increased withdrawals of water, is discussed in a cooperative report prepared by the U.S. Geological Survey and the Texas Board of Water Engineers. Withdrawals of ground water for municipal, industrial, and irrigation purposes in the Houston area averaged 284 mgd in 1951 and 308 mgd in 1952, compared to 254 mgd in 1950, the joint agencies note.

The increase in withdrawals was largely concentrated in the city well fields and in the Pasadena industrial area, with 49 ft the largest recorded decline of artesian pressure. In the Katy rice-irrigation area, water levels continued to decline slowly as withdrawals increased from 98 mgd in 1950 to 128 mgd in 1952.

Later the report will be published by the Texas Board of Water Engineers in its bulletin series.

## Finished Steel Shipments Set Record in 1953

Finished steel shipments in 1953 totaled 80,151,893 net tons, an increase of more than 12.1 million tons over 1952, according to an announcement from the American Iron and Steel Institute. Many industries set new records for consumption of steel during the year, with the consumer durable goods market showing the greatest increase. Shipments to the automotive industry, at nearly 14.7 million tons, were more than 3.8 million tons greater than in 1952 and represented the largest increase of any market in tons. The electrical machinery and construction markets were also up. Direct shipments for construction came to 13.2 million tons, or 27 percent more than in 1952.

Large drops in shipments are reported for exports, shipbuilding, and agricultural markets. The decline in exports is attributed to increased competition from foreign sources, while drops in shipments for agriculture and shipbuilding reflect a tapering-off of activities in these fields.

## Duquesne Light Co. to Build Atomic Power Plant

A proposal submitted by the Duquesne Light Co., of Pittsburgh, Pa., for participation in the construction and operation of the nation's first full-scale central station nuclear power plant is the most favorable to the government, according to an announcement from the Atomic Energy Commission, which is negotiating a formal agreement with the company. Under the Duquesne proposal, the company would furnish a site for the entire project and build and operate a new electric generating plant at no cost to the government; operate the reactor part of the plant and bear the labor costs involved; assume $5,000,000 of the cost of research, development, and construction of the reactor portion of the plant; and purchase steam developed in the reactor from AEC.

The proposed site for the 60,000-kw plant is on land owned by the company in the Greater Pittsburgh Area. The reactor is of the type known as a Pressurized Water Reactor, meaning that it will be cooled and moderated by ordinary water under pressure. The Westinghouse Electric Corp. has a contract with AEC to develop, design, and construct the reactor portion of the plant.

## Major Brazilian Contract Goes to New York Firm

A contract to develop a 135-mile jungle railroad and port facilities in Brazil has been awarded to Foley Brothers, Inc., construction engineers of Pleasantville, N.Y. The contract was made with Industria e Comercio de Minerios, S.A., Brazilian government concessionaire for the Serra do Navio manganese deposits. About three years will be required for completion of the project, which will facilitate the development of manganese deposits located in the Federal Territory of Ampa. The railroad will connect the mines with the port installations to be built on the north bank of the Amazon River, near the city of Macapa.

## Robert Moses Named State Power Chairman

Robert Moses, New York City Construction Coordinator, has been selected by Gov. Thomas E. Dewey to serve as chairman of the New York State Power Authority, replacing John E. Burton, former state budget director. As chairman he will be responsible not only for directing and supervising construction of New York State's share of the projected $300,000,000 St. Lawrence River hydroelectric project, but also of fighting for Congressional approval for state development of additional hydroelectric power at Niagara. Mr. Moses will retain his various posts in the city government.

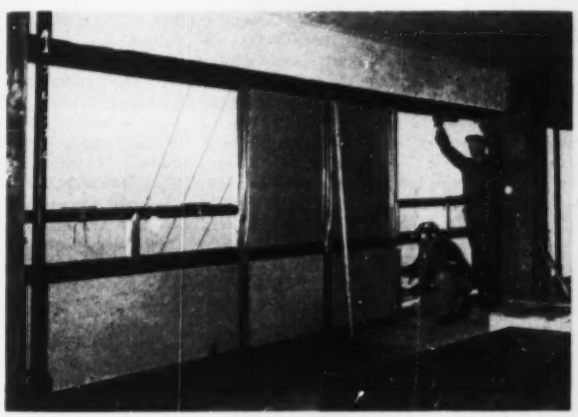
In making the appointment, Governor Dewey expressed the hope that construction of the controversial project can be started this year. Recently the State Power Authority was licensed by the Federal Power Commission to build the necessary dams and generating facilities in cooperation with Canada. At present, however, construction is being held up by litigation in the federal courts.

## Hartford Statler Makes First Use of Metal-Glass Walls

A revolutionary type of exterior wall is being applied for the first time to a multistory building—the 16-story Hotel Statler in Hartford, Conn. Application of this skin-type exterior wall, which will completely enclose the building, was begun recently. The wall consists of picture windows, aluminum trim, and sections of metal treated with porcelain. Back of this "skin" is a hard core backed with heavy insulation, behind which is a structural panel of asbestos board. The construction is completely waterproof and has a low heat transmission factor, making it easy to heat.

While a glass and metal outer surfacing has been used on some industrial and other buildings, such construction has previously been confined to facing the outside of conventional masonry walls. Although the Statler walls are not as thick as conventional masonry, they are stronger and provide better fire protection, according to J. P. Travis, president of the Universal Corporation of Dallas, Tex., which is providing the wall. Prefabricated and put up in sections, they can be installed in about half the time needed for masonry walls, and the cost is about the same. Mounting the skin on a structural steel subframe makes possible a floating type of exterior wall, which is subjected to less strain if settlement occurs or there is sway in high winds. Pressure escapes are installed to relieve vapor pressure, which can mount to 200 psi when the sun shines on the facing. The hard, shiny surface will cleanse itself when it rains, saving maintenance.

The top 14 stories of the Hotel Statler will have walls of the metal-glass, but the lower two floors will be of textured masonry in front to blend with the landscaped main entrance. William B. Tabler is architect and designer of the building, which is expected to be ready for occupancy in the early summer of 1954.



The Hartford Statler as it will look when completed early this summer is shown in photo of model. In the small view a workman is seen installing a section of glass-metal wall. Inside the glass-metal wall is a heavy application of insulating material and of heavy structural core, and within that the inner construction of the building.

During construction of Allegheny County's new multi-span hangar recently completed at Greater Pittsburgh Airport (upper photo) temporary erection towers were placed under each arch quarter-section to hold it at the proper elevation until the center quarter-sections could be hoisted into position by cranes. Roofing and insulation for the structure (shown in left-hand photo) were erected at the same time from the top side of the roof, eliminating the need for scaffolding. Structure was designed by the Ideco Division of the Dresser-Stacey Co., Columbus, Ohio.

# New Pittsburgh Airport Hangar Features 278-Ft Three-Hinge Trussed Arch Spans

A $1,000,000 hangar that sets a new span record for three-hinged arch structures has recently been placed in service at Allegheny County's Greater Pittsburgh Airport. Designed by the Ideco Division of the Dresser-Stacey Co., Columbus, Ohio, the structure features a box-shaped, three-hinge 278-ft trussed steel arch—one of the longest spans of such design ever built. The hangar will be leased to Capital and Trans-World Airlines to house maintenance facilities and to provide office, storage, and shop space. Total hangar area is 74,000 sq ft, with an additional 26,000 sq ft of office and shop space provided at the rear between the hangar and a similar unit being erected next to it. Each hangar is equipped with a set of electrically operated bottom rolling doors, which permit a clear opening 40 ft high by 255 ft wide. Doors nest in pockets at each side of the opening.

Three-hinge trussed arches, each spanning 278 ft, form the main structural framework for the new hangar. Arches are spaced 25 feet on center. The arch section is composed of four chord angles arranged in a box section 4 ft wide and varying in depth from 8 to 14 ft. The end arches are braced in pairs for proper structural rigidity and to transmit wind loads from the end walls of the hangar. Hinged connections are provided at each arch base and at the crown joint at the centerline of the span. A pair of tie rods at each arch, consisting of solid round rods placed under the hangar floor, are provided to transmit the arch thrust.

Structural dead load for the steel design was small—23 psf. This is attributed to the use of lightweight insulated steel roofing, use of welding, and the weight-saving advantage obtained by the use of three-hinged trussed arch design. Three conditions of loading were considered in the design: 30-psf snow load on the entire span in addition to the dead load; 30-psf snow load over the one-half span in addition to the full wind load and dead load; and wind load plus dead load only. In combination with wind loads, the snow load was considered to be loaded on the leeward half of the arch only.

Wind pressures used in the design computations were in accordance with the recommendations of ASCE Sub-Committee 31 (TRANSACTIONS, Volume 105, 1940). For vertical surfaces projected to the wind, a wind pressure of 20 psf was used. For the rounded roof above the eaves the following wind pressures were used: windward quarter of the roof arc, 12-psf suction; central half of the roof arc, 13.52-psf suction; and leeward quarter of the roof arc, 9-psf suction. Windloads were combined with snow load and dead load, as previously described.

Each hangar roof is supported on six three-hinge trussed arches. The arches have a depth of 8 ft at the base and at the crown hinges, and a uniformly increasing depth toward the eaves where the section is 14 ft in depth. The rise at the center of the 278-ft span is 76 ft center-to-center of the hinge pins.

Each arch was completely fabricated from structural angles and plate. Each complete arch assembly weighed 42 tons exclusive of purlins, bracing, and sheeting.

With the hangar structures resting on a new fill of inadequate bearing capacity, it was necessary to support the entire structure on piling. Franki concrete displacement piles, varying in length up to 45 ft, support the pads under each arch bearing, under the door rail supports at the front of each hangar unit, and under the main bearing points for the wall construction. Grade beams spanning between the main bearing points support both exterior and interior wall construction.

The arch quarter-sections at each side of the span were erected with the base hinge pins driven into place. Temporary erection frames were placed under the quarter-sections to hold them at the proper elevation. All purlins, struts, and bracing were then bolted to the pair of arch quarter-sections at each end forming a well-braced rigid structure. Finally, two cranes with a 90-ft boom and a 25-ft jib raised the two center quarter-sections into place, after which the chord splices were made and the crown hinge pins were driven into place.

Before the arch load was released, the arch ties below the floor line, were pretensioned and connected to transmit the arch thrust. After complete erection of all struts, purlins, and bracing in the first bay, the arches were erected, one at a time, utilizing the temporary erection frames and procedures previously described. The twelve arches, the purlins, and the bracing were erected in approximately 9,200 man-hours.

All construction was under the direction of John B. Sweeney, director of aviation and Edward G. Messner, M. ASCE, assistant director of aviation and chief engineer for the Allegheny Department of Aviation. The complete steel hangar superstructure and the power-operated hangar doors were designed, fabricated, and erected by the Ideco Division of the Dresser-Stacey Co., in cooperation with Leland W. Cook, A.M. ASCE, consulting engineer, and Joseph Hoover, consulting architect, both of Pittsburgh, who represented the County of Allegheny. Elwin G. Smith & Co., of Pittsburgh, did the steel erection under subcontract to the Ideco Division. The Allegheny Building Company of Pittsburgh was the general contractor.

The material from which this item was prepared was supplied by Thomas W. Singell, A.M. ASCE, and R. A. Vaughan, chief building design engineer and, structural products manager, respectively, for the Ideco Division.

## Good Construction Year Forecast at AGC Convention

The Associated General Contractors of America held its thirty-fifth annual convention at the new Statler Hotel in Los Angeles, March 1-4, with 2,000 of its 6,500 member firms represented—perhaps the largest convention in AGC history. Predictions of "Future Business and Market Conditions"—all favorable—were the significant convention feature, in addition to the serious committee study given such subjects as highway, building, and heavy construction; apprentice training; accident prevention; market development; legislation; contract forms and specifications; relations with labor; and cooperation with engineering and architectural societies.

In a leading talk, Clifford F. Hood, president of the United States Steel Corp., told the convention, "For the present we have the economic momentum of large capital investment in new plant and equipment. There are indications that projects underway or earmarked for the future will triple the toll road system in the United States. The brightest picture centers around estimates of construction contract awards for the coming year. These indicate another $34 billion expenditure, and if the estimators are off in their calculations, as they were in 1953, this figure could well approach $36 billion [in 1954]."

A similar view was expressed by H. E. Foreman, managing director of AGC, who said "If these forecasts [for $34 billion of new construction in 1954] prove correct, 1954 will be the second biggest year in history for the construction industry."

Secretary of Labor James P. Mitchell told the convention in a tape-recorded address that the country is not "going from boom to bust. There may be a slight increase in unemployment for the next two months, and then for another two months we will rest at that level." Mr. Mitchell described this as "part of a necessary readjustment that we could only postpone, not avoid." Government statisticians believe there will be increased spending in some important types of construction this year, which will almost offset expected declines in other categories, he said.

Carl F. Oechsle, Deputy Assistant Secretary of Commerce for Domestic Affairs, reported that a joint survey of building plans for 1954 made by the Labor and Commerce Departments indicates a construction volume only 2 percent lower than the record volume of last year. Among many factors considered in arriving at this estimate are the following: Engineers and architects had 25 percent more work on their drawing boards in January this year than one year ago; General Motors plans a two-year billion-dollar program of expansion; and the steel industry plans to spend $750 million on expansion this year.

Expressing the bankers' view, Robert L. Gordon, vice-president and senior loan officer of the Bank of America, Los Angeles, said, "For most of the past twelve years business and industry have been burning the candle at both ends. Now is a good time to change that. There is a feeling that in the contracting field there could be an increasing number of failures in 1954. Weak firms will become strong or give way to the strong." M. Gordon deplored tendencies noted in some contractors to expose themselves unduly by underbidding, by over-purchase of equipment, by retaining too-large overhead staffs, by accepting unfamiliar work, and by failure to obtain written requests to perform work not covered by the contract. Nevertheless, Mr. Gordon states, "I do not feel that we are headed for a collapse. None of the speculative conditions that existed in 1929 exists at this time."

Recognizing the current period of economic adjustment, Richard J. Gray, president of the Building and Construction Trades Department of the A.F. of L., Washington, D.C., said that this is the time for labor and management in the building industry to chart out a positive constructive course for the future of the industry.

John MacLeod (left), of Paramount, Calif., newly elected president of AGC, chats with his predecessor in office, C. P. Street, of Charlotte, N.C.

Formal addresses were made by Brig. Gen. C. H. Chorpening, M.ASCE, Assistant Chief of Engineers for Civil Works; Rear-Admiral J. R. Perry, Chief of the Bureau of Yards and Docks, Department of the Navy; and W. A. Dexheimer, M. ASCE, Commissioner of Reclamation. The convention went on record in favor of increasing federal aid for highway construction to not less than $900 million annually, and opposed diversion of highway tax funds. It also recorded its conviction that engineers' salaries must be commensurate with their responsibilities and proposed to cooperate with ASCE and other engineering societies to that end.

At the closing session of the convention, AGC President C.P. Street, McDevitt & Street Co., Charlotte, N.C., inducted President-elect John MacLeod, president of the Macco Corp., Paramount, Calif., into office as top AGC officer for 1954.

## Reservoir Improvement to Expand Los Angeles Supply

Lower Stone Canyon Reservoir, a large water-storage basin in the mountains above the west Los Angeles area, will be enlarged and improved at an estimated cost of $4,000,000, under a project authorized by the Board of Water and Power Commissioners. To meet the increasing need for water in the fast-growing western part of the city, the present 120-ft depth of the reservoir will be increased by 18 ft, raising its total capacity to 10,000 acre-ft, an increase of over 3,250,000,000 gal. While the reservoir is out of service, water will be supplied to the city from the new Upper Stone Canyon Reservoir, which was placed in service in January.

ASCE Director Samuel B. Morris is general manager and chief engineer of the Board of Water and Power Commissioners, which is carrying out a multi-million-dollar program for the construction of new reservoirs, pipelines, and mains, and improvement and enlargement of existing facilities.

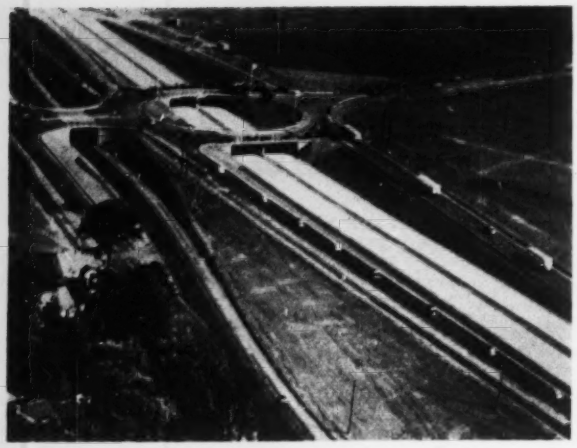
## Small Nuclear Power Plant Developed for Military Use

The Atomic Energy Commission is investigating the possibility of building and operating a small (1,250-kw) nuclear power plant, the prototype of a unit which would meet military requirements for use in remote locations and an Arctic environment. The AEC is canvassing interested industrial firms to determine the extent of the firm's interest as a prime contractor and to evaluate its capabilities. Invitation to bid will follow these evaluations. The firm selected must design, procure equipment and materials, and construct the prototype plant and then maintain training facilities for military operating personnel, all under a fixed price contract.

A preliminary design for the proposed prototype nuclear power plant has been made at the Oak Ridge National Laboratory (ORNL). It contemplates a self-regulating reactor with a core of stainless-steel-clad enriched-uranium fuel elements moderated and cooled by water at 1,200-psi pressure and with simple but adequate automatic controls to protect it against operational accidents. The reactor can be built, the AEC advises, entirely within the bounds of existing technology.

Specified maximum shut-down time is for two weeks once a year for refueling, with maximum intermediate operating shut-downs of two hours. To allow for transport by air the largest prefabricated component of the plant will be 9 by 9 by 27 ft and will weigh 10 tons.

Construction of the prototype plant is to be on an AEC or U.S. military base in continental United States. L. R. Hafstad is AEC Director of Reactor Development, Washington, D.C.



## *Swedish Superhighway Is Opened to Traffic*

**Traffic moves freely onto and off Sweden's new ultra-modern superhighway, recently opened between the university city of Lund and Malmo, noted for its harbor and industry. Many approaches and 27 bridges and viaducts prevent traffic tie-ups at crossings. Built at a cost of about $400,000 per mile, the eleven-mile Autostradan replaces Sweden's first paved road built half a century ago. There are four lanes, each 23 ft wide, with a 10-ft-wide grass strip dividing opposing lanes of traffic. Large fleets of American machinery were used on the project, which involved moving 650,000 cu yd of dirt. Begun in May 1952, the Autostradan was ready for use in the fall of 1953. Photo courtesy Caterpillar Tractor Co.**

# N. G. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

With Esseyeville soon to be host to engineers from Arizona, Hawaii, Nevada, Oregon, Utah and the rest of California, the April meeting of its Engineers Club ran on and on with last-minute arrangements. Professor Neare had to wait, fume, fret, and wait.

Ordering buses for the tours ended the agenda. Guestimating the number of visiting members, they took the number of ladies at half as many plus half a lady, and the number of students at 23 percent less plus half a student.

For the ladies' tours to Governor's Mansion and The Village, each bus could take one-fourth the ladies plus half a lady. For the final Folsom Dam tour they ordered enuf buses to just take everybody, including 727 local members. "Keep it a secret," begged the Professor, "and I'll give a free ride to the first visitor who tells me how many buses we ordered."

"Since it's past midnite, I'll rush thru the problem of the Yawaraf Breakfast, skipping Joe Kerr and his . . ."

"No, you don't!" hollered Joe. "When I'm thru, you can skip Cal. The yawar, the awara and the waraf had to start for one another from the vertices of an equilateral triangle with 2-mile sides, traveling at a mile a minute or 2 miles in 120 sec. So I made a peg model with 10-ft sides and moved each peg an inch at a time, counting a second for each move. The 3 curves, looking like a pinwheel (Fig. 1), were less than an inch apart after 80 sec, so I figured the greedy beasties swallowed each other in the 81st second. That's the kind of breakfast I like; no leftovers."

"My, what a lot of work to avoid an easy job!" chided Cal Klater. "At any instant from tri-symmetry, the beasties are at the vertices of a dwindling equilateral triangle which rotates as it approaches a fixed centroid as a limit. Each beastie is always headed along the side of the rotating triangle, or at an angle of 30° from the radius vector to the centroid, so the path is an equiangular or logarithmic spiral, with the simple equation, $\log r = \theta \cot 30°$.

"However, we don't have to rectify this curve. The centripetal component of the velocity is $v \cos 30°$, or $\cos 30°$ for $v = 1$ mile/min. The initial radius vector was $\sec 30°$, so the elapsed time was $\sec 30°/\cos 30° = {}^4/_3$ min. Breakfast was wolfed at 6:01:20 a.m."

"Which reminds me of the old saw, 'The early bird gets the worm' and the moral, 'Don't be an early worm'," mused the Professor. "For another viewpoint, note that while the yawar at any instant is running at unit velocity toward the awara, the awara's course is veering 60 deg, with a component of $\cos 60° = {}^1/_2$ toward the yawar. To close the initial 2 miles between them will take $2/1.5 = 4/3$ min. It wasn't as hard as it looked, was it?"

[*Cal Klaters were Richard Jenney, A Nuther Nutt, Stoop (John L.) Nagle, Col. Wunfootongrounski (Ray Adams), Flo Ridan (Charles Edson), Jerald N. Christiansen, Ad L. Pate (G. H. Wilsey), Claw (William R.) Hemmer, Hy Drawg (L. A. Stanley), George C. Stewart, Sauer Doe (Marvin Larson), Edwin A. Verner, R. E. Philleo, Don'T (Don Thayer), Ignor Antenuff (Paul Hartman), GI (Morton) Raff, Abbot Sackheim and R. W. Meyer. Esseyeville for the moment is Sacramento.*]

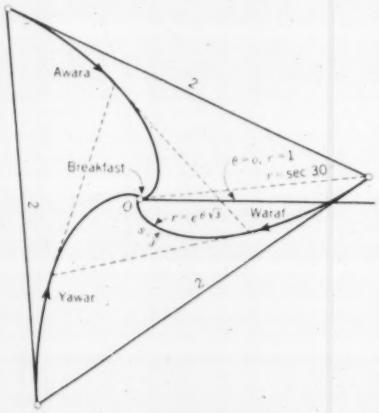



**Fig. 1. Breakfast was a maelstrom of conspiralation at the center of Yawaraf.**

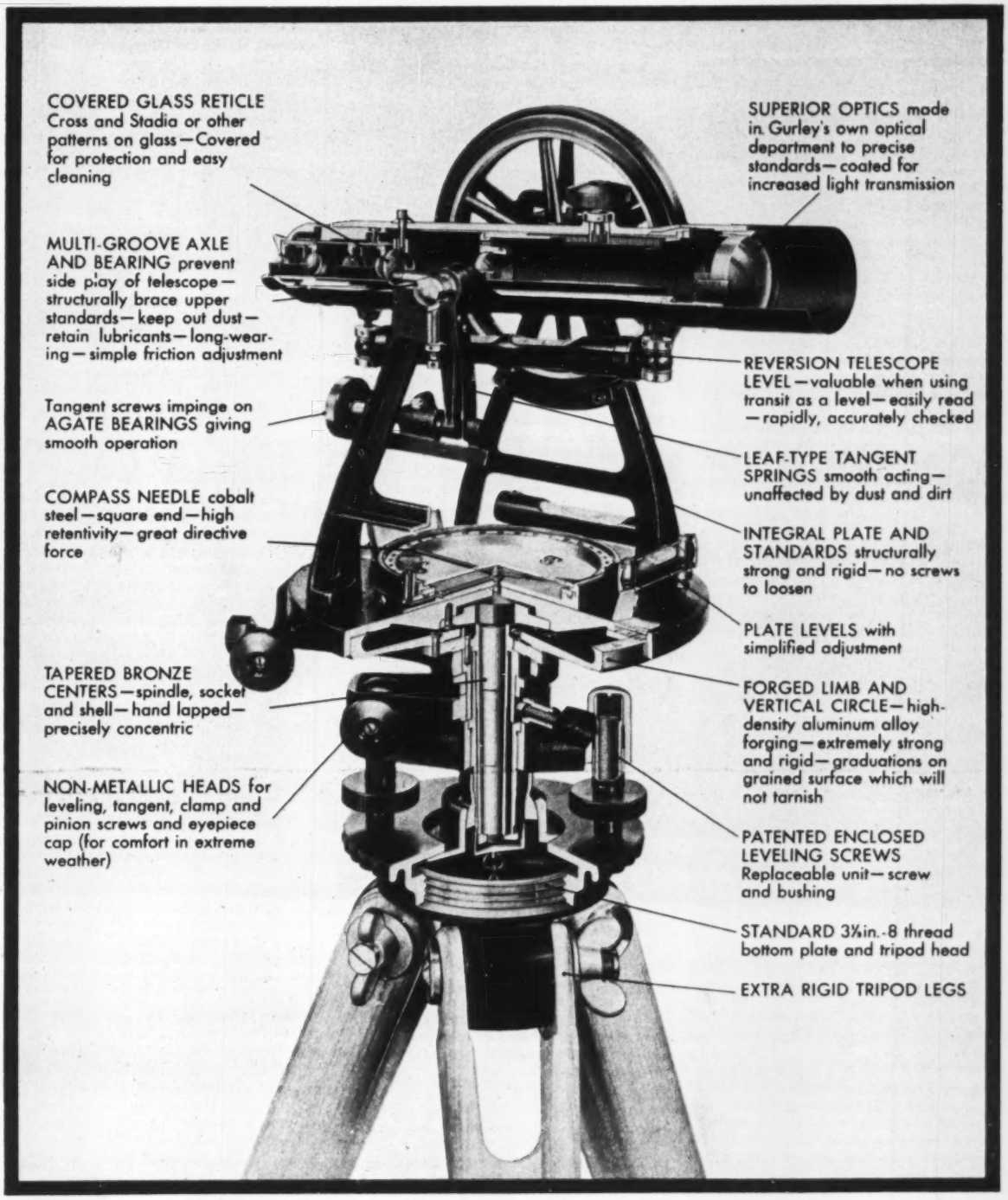
## Pan-American Road Congress To Meet in Caracas in July

Preliminary arrangements are being made for the Sixth Pan-American Highway Congress, which will open a ten-day meeting in Caracas, Venezuela, on July 11. Colorful tours of Venezuela, the Andes Mountains, and Amazon River areas are being planned for the delegates in addition to a full technical program. An Organizing Committee, with Dr. Eduardo Arnal, president of the Venezuelan Society of Engineers, as executive secretary, has been set up. The Pan-American Division of the American Road Builders Association, Washington, D.C., is aiding in working out details.

## Engineers' Starting Salaries at New High

Average starting salaries of January engineering graduates at Illinois Institute of Technology, reached an all-time high of $373 per month this year—an increase of $32 over a year ago and $11 more than last June. The average is based on a survey of mid-year engineering graduates by Earl C. Kubicek, director of alumni relations and placement at Illinois Tech. The figures are for students receiving a bachelor's degree and planning to work a 40-hour week.

Chemical engineering graduates received the most lucrative starting salaries, with an average of $394 compared to the January 1953 figure of $327. Other engineering fields and the average salaries received by mid-year graduates of 1953 and 1954 follow (with the 1954 figures listed first): Civil, $388 ($353); mechanical, $370 ($353); electrical, $367 ($345), and industrial, $350 ($356).


COVERED GLASS RETICLE
Cross and Stadia or other patterns on glass—Covered for protection and easy cleaning
MULTI-GROOVE AXLE AND BEARING prevent side play of telescope—structurally brace upper standards—keep out dust—retain lubricants—long-wearing—simple friction adjustment
Tangent screws impinge on AGATE BEARINGS giving smooth operation
COMPASS NEEDLE cobalt steel—square end—high retentivity—great directive force
TAPERED BRONZE CENTERS—spindle, socket and shell—hand lapped—precisely concentric
NON-METALLIC HEADS for leveling, tangent, clamp and pinion screws and eyepiece cap (for comfort in extreme weather)
SUPERIOR OPTICS made in Gurley's own optical department to precise standards—coated for increased light transmission
REVERSION TELESCOPE LEVEL—valuable when using transit as a level—easily read—rapidly, accurately checked
LEAF-TYPE TANGENT SPRINGS smooth acting—unaffected by dust and dirt
INTEGRAL PLATE AND STANDARDS structurally strong and rigid—no screws to loosen
PLATE LEVELS with simplified adjustment
FORGED LIMB AND VERTICAL CIRCLE—high-density aluminum alloy forging—extremely strong and rigid—graduations on grained surface which will not tarnish
PATENTED ENCLOSED LEVELING SCREWS Replaceable unit—screw and bushing
STANDARD 3⅝in.-8 thread bottom plate and tripod head
EXTRA RIGID TRIPOD LEGS

**The Gurley Precise Transit**

**W. & L. E. Gurley, Troy, N. Y.**

GURLEY

# DECEASED

**Charles McKnight Africa** (A.M. '31), age 57, head of the J. Murray Africa Co., Huntingdon, Pa., died at his home in that city on February 20. Before entering the family engineering practice in 1933, Mr. Africa worked for the Fred Snare Corp., in Louisiana, New Jersey and Pennsylvania. At various periods he served as borough engineer for Huntingdon and Mount Union. He was an alumnus of Rensselaer Polytechnic Institute, class of 1923.

**Thomas John Allan** (A.M. '13), age 90, retired engineer of San Francisco, Calif., died in that city on August 19. After practicing as a consultant in the San Francisco area from 1924 to 1944, Mr. Allan was associated with Joslyn & Ryan, as a naval architect until his retirement in 1948. In his early career he was chief engineer for an Oakland realty organization and the Standard Oil Co. of California.

**Ernest Henry Barkmann** (M. '30), age 75, who was continuously connected with the Missouri Valley Bridge & Iron Co., Leavenworth, Kans., from 1903 to 1948, died several months ago. After graduating from Kansas University in 1903, he joined the company as a draftsman, advancing to assistant chief engineer in 1923 and chief engineer in 1937. Mr. Barkmann's assignments took him all over the United States and Mexico.

**John Van Derveer Beekman, Jr.** (M. '18), age 78, of West Newton, Mass., who retired in 1925 after ten years as president and director of the Whidden-Beekman Co., of Boston, died last year. Mr. Beekman was manager for Purdy & Henderson, in Boston, from 1904 to 1908, and general manager for Whidden & Co., from 1908 to 1915. He was a graduate of the Massachusetts Institute of Technology.

**Gurdon Gilmore Black** (M. '13), age 72, since 1948 engineer with the Fruin-Colnon Contracting Co., East St. Louis, Ill., died on August 26. Mr. Black was assistant engineer in charge of the St. Louis Water Department from 1901 to 1917. After service in World War I he joined the McCormack-Combs Construction Co., of St. Louis, advancing from engineer to vice-president, treasurer, and partner during a twenty-year association (1919–1939). For several years he was project manager for the St. Louis Ordnance Plant, East St. Louis. He was an alumnus of Washington University.

**Guy Brown** (M. '47), age 66, since 1911 a member of the St. Louis (Mo.) Division of Sewers and Paving, Department of the President of the Board of Public Service, died at his home in St. Louis on January 15. Mr. Brown was in charge of sewer design from 1919 to 1940, when he was named chief engineer of the Division. A 1910 graduate of the University of Missouri, he served in World War I as a first lieutenant in the Corps of Engineers.

**Roy Dayton Burdick** (M. '46), age 61, colonel, U. S. Army (retired), and consulting engineer of Little Rock, Ark., died on March 2 in the Walter Reed Army Hospital while on a trip to Washington, D.C. Colonel Burdick, who served in the army from 1916 until his retirement in 1946, entered the Corps of Engineers in 1920. He was stationed in the Honolulu, Philadelphia and Memphis engineer districts from 1920 to 1940, and during the war years served as engineer for the Third Air Force at Tampa, Fla.; and engineer supply officer in Army Service Forces depots at Ogden, Utah, and Columbus, Ohio. He had been deputy division engineer for the Corps of Engineers at St. Louis, and district engineer at Little Rock, Ark. He graduated from Cornell University in 1914.

Roy D. Burdick

**Frank Lemuel Clapp** (M. '15), age 82, retired engineer of Dorchester, Mass., died in June 1953. In his early career, Mr. Clapp was connected with the Metropolitan Water Board of Boston; the office of the city engineer of Waterbury, Conn.; the Board of Water Supply of New York City; and Fay, Spofford & Thorndike, Boston. From 1917 to 1927 he was assistant registrar at the Massachusetts Institute of Technology, and from 1927 until his retirement in 1948 he was active in real estate and administrative work for the First Parish Church of Dorchester. Mr. Clapp was an alumnus of Massachusetts Agricultural College.

**William Greer Dow** (A.M. '10), age 73, former construction superintendent for the St. Joseph Lead Co., of Josephtown, Monaca, Pa., died on October 29 in Denver, Colo., where he had been residing since his retirement in 1950. Connected with the St. Joseph Lead Co. for 33 years, Mr. Dow had previously been with the U.S. Reclamation Service in Nebraska; the Eden Irrigation and Land Co., Eden, Colo.; and the Hardaway Construction Co., Whitney, N.C. For several years he had a private practice in Denver. He graduated from the Colorado School of Mines in 1906.

**Cuvier Greene** (A.M. '23), age 61, for the past five years specification engineer for Quinton Engineers, Ltd., Los Angeles, Calif., died in that city on December 28. After studying at the Massachusetts Institute of Technology, Mr. Greene was employed by several Kansas City (Mo.) firms, including the Union Electric Light & Power Co., and Waddell, Harrington & Howard. In 1925 he moved to the West Coast, where he had been with Morgan, Walls, and Clements; Leeds, Hill, Barnard & Jewett; and the Pickard Construction Co. Mr. Greene was in private practice from 1930 to 1941.

**Michael Gregor** (M. '34), age 65, retired consulting aeronautical engineer, of Miami, Fla., died on December 14. Before coming to the United States in 1921, Mr. Gregor was with early aircraft companies in Russia and France. In this country he was successively associated with the Gallaudet Aircraft Corp., Dayton Wright Co., Bird Aircraft Co., Seversky Aircraft Co., Canadian Car & Foundry Co., and the Chase Aircraft Co. He was a graduate of the Institute of Ways and Communications of St. Petersburg.

**Meier George Hilpert** (M. '16), age 75, president and treasurer of Hilpert Developments, Bethlehem, Pa., died on February 11. Retiring in 1945 after 42 years of continuous service with the Bethlehem Steel Co., Mr. Hilpert organized Hilpert Developments. As a lieutenant commander in the U.S. Navy during World War II he assisted in the development of F. R. Harris Sectional Floating Dry Docks. He also held patents for composition and paneled building and bridge construction. He was an alumnus of the State University of Iowa and Cornell University.

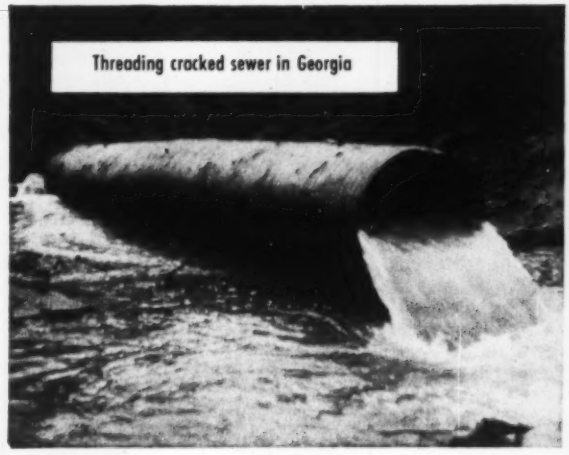
**Gunni Jeppesen** (M. '21), age 74, died on January 20 at Cuyahoga Falls, Ohio, where he had been residing since his recent retirement as structural engineer for the Chicago Bureau of Engineering. Before joining the Bureau in 1939, he had been assistant engineer, chief engineer, and consultant to the Strauss Bascule Bridge Co., Chicago; structural engineer with the Leonard Engineering Co., Chicago; contract engineer, Chicago Bureau of Design; bridge engineer, Illinois Division of Waterways; and design engineer with Charles De Leuw & Co. Mr. Jeppesen was educated at the State Polytechnic Institute of Copenhagen.

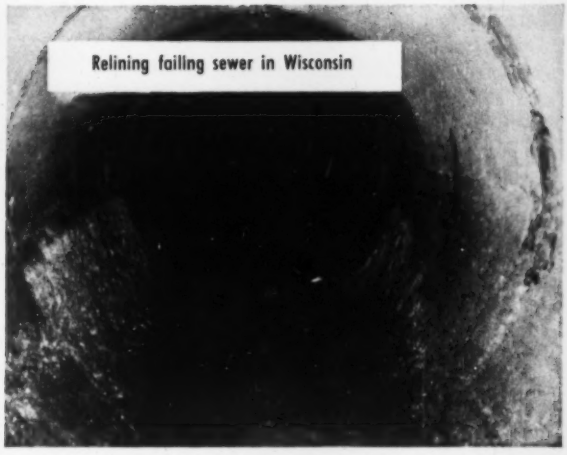
**Francis Whittier Johnson** (A.M. '18), age 64, district manager of the Raymond Concrete Pile Co., at Syracuse, N.Y., died on February 18. He had been associated with the firm as sales engineer and district manager of the Cleveland territory from 1920 to 1932, and was in the New York City and Syracuse areas from 1946 until his death. Intermittently Mr. Johnson was engaged as a manufacturer's representative and president of the Johnson Foundation Co. He had studied at Franklin Union.

**Henry Leser** (M. '28), age 76, retired engineer of Indianapolis, Ind., died in that city on February 18. From 1906 until his retirement in 1929, Mr. Leser was engaged in subway construction work in New York City holding the positions of assistant engineer and resident engineer with the Manhattan Elevated Railway and Subway Division, the Interborough Rapid Transit Co., and the Brooklyn City Railroad Co. Earlier he was with the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad for six years.

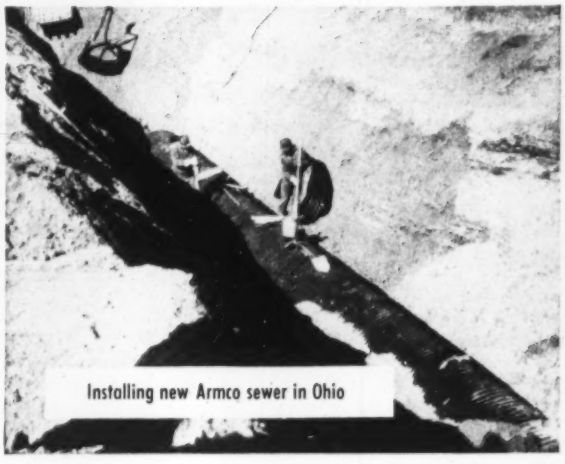
**Frank Stanley Parker** (A.M. '23), age 65, consulting engineer, architect, and senior partner in the firm of Frank S. Parker Associates, New York, N.Y., died while en route to a meeting of the New York State Department of Conservation at Albany, on March 2. He was a member of a three-man board of advisers to the New York State

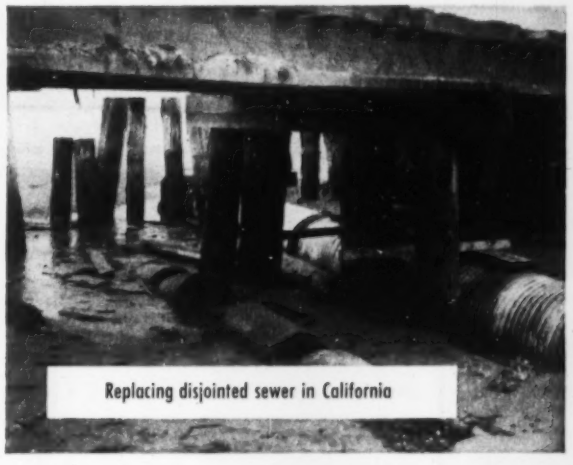
(*Continued on page 94*)




# Which Armco sewer saved the most money?




Was it relining the failing sewer; threading the cracked pipe; replacing the disjointed structure; or installing an Armco Sewer in a brand-new installation? Fact is, they *all* saved plenty of money. But considering original costs, the *new* Armco Sewer will save much more through the years.

The new Armco Pipe will be faced with the same hazards that were disastrous to the other structures. But because of the flexible strength of corrugated metal, there is no danger of cracking. Positive bolted connections eliminate disjointing. And with Armco ASBESTOS-BONDED Pipe, the corrosive sewage will not cause damage. A long life for the new Armco Sewer is assured.

No two sewer problems are alike. But Armco can supply a structure to solve practically all of them. Armco Corrugated Metal Pipe and Pipe-Arch are recommended for normal sewer use; ASBESTOS-BONDED Pipe and Pipe-Arch for severe corrosion problems; MULTI-PLATE Pipe, Arch and Pipe-Arch for large area requirements. For sizes and other factual details, write us. Armco Drainage & Metal Products, Inc., 1394 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: Write Guelph, Ontario. Export: The Armco International Corporation.

**Armco Sewer Structures**

ARMCO

## Deceased

(*Continued from page 92*)

Commissioner of Conservation. Known for his early work in the design of reinforced concrete buildings, Mr. Parker maintained offices in New York since 1921.

**Emile George Perrot** (M. '11), age 81, architect and engineer engaged in private practice in Philadelphia, Pa., since 1920, died on February 7. A pioneer in the field of reinforced concrete, Mr. Perrot was the author of numerous articles and the designer of such industrial buildings as the American Viscose Co. plant at Marcus Hook, Pa., and the Victor Talking Machine Co., Camden, N.J. While a partner in the firm of Ballinger & Perrot (1901–1920), he developed and patented the unit girder frame system of reinforced concrete, which was officially adopted by the U.S. government. Mr. Perrot was an alumnus of the University of Pennsylvania.

**John Stearns** (M. '33), age 72, executive assistant in the office of the manager and director of services of Hughes Aircraft Co., Culver City, Calif., died in Los Angeles, on January 21. Prior to joining Hughes in 1942, Mr. Stearns was a construction superintendent for the J. G. White Engineering Corp., New York, and Mesmer & Rice, Los Angeles; vice-president of Frank Couzens Inc., Birmingham, Mich.; and resident and division engineer for the Metropolitan Water District of Southern California. Mr. Stearns was a graduate of Cornell University.

**John Dickson Stevenson** (M. '25), age 72, since 1945 chief engineer of the Pittsburgh (Pa.) Department of Public Works, and an alumnus of Rensselaer Polytechnic Institute, died in Pittsburgh on October 28. Except for brief engagements with county and state agencies, Mr. Stevenson had been with the Department of Public Works since 1906. Joining the department as an inspector in the filtration division of the Water Bureau, he advanced to director of the Bureau of Engineering in 1936 and assistant chief engineer in 1942.

**Albert Maser Traugott** (M. '22), age 71, who retired in 1949 as chief engineer of the Virginian Railway Co., Norfolk, Va., after 22 years in the position, died in Norfolk, on January 1. He was connected with the Virginian line since 1903, beginning as a rodman and advancing to division engineer in 1913, assistant chief in 1920 and chief engineer in 1927. He attended Purdue University.

**Alden Wells** (M. '47), age 67, deputy manager and chief engineer of the Bureau of Public Works, Metropolitan District, Hartford, Conn., died in that city on January 14. A graduate of Yale University in 1907, Mr. Wells entered the Hartford municipal service in 1909. He had been assistant engineer, division engineer, deputy manager and (since 1948) chief engineer.

**Charles A. Winston** (M. '27), age 86, since 1921 a member of Freeman & Winston, civil and consulting engineers of West Orange, N.J., specialists in land surveying, died at Montclair, N.J., on January 22. Mr. Winston served as town engineer of West Orange from 1916 to 1921, and of Livingston from 1923 to 1931. Early in his career he was in the city engineer's office in Passaic, and served as chief engineer for V. J. Hedden Sons Co., Newark, and W. H. Fissell & Co., New York.

# NEWS OF ENGINEERS

**Paul W. Abeles,** consulting engineer and graduate lecturer on prestressed concrete in the Brixton School of Building, London, began his second lecture tour on prestressed concrete in the United States at the University of California on March 1. His six-week tour of a dozen engineering colleges will end at Northeastern University on April 15.

**Gordon D. Anderson** associated with **James A. Lindsey,** of Hutchinson, Minn., in a general civil engineering practice with headquarters in Hutchinson. Mr. Anderson is a 1950 engineering graduate of the University of Minnesota and has had experience with Hitchcock & Estabrook, Inc., Minneapolis, and the Minneapolis regional office of the U.S. Fish and Wildlife Service.

**M. D. Morris,** for the past five years associated with Soiltest, Inc., of Chicago, in a sales engineering capacity, has been appointed Eastern representative for the company. He has his headquarters at 545 Fifth Avenue, New York, N.Y.

**Frank Neumann,** who retired in August as chief of the Seismological Branch of the U.S. Coast and Geodetic Survey, is now serving as director of the Seismological Station of the University of Washington.

**George B. Bodwell,** president of Bodwell-Lemmon Co., Cleveland, Ohio, was recently named president of the Cuyahoga Composition Roofer's Association.

**Donald P. Barnes,** who has been on the staff of Knappen Tippetts Abbett McCarthy since 1952, first in Athens, and more recently in Rangoon, Burma, is currently serving a two-year term as technical adviser to the Prime Minister's Economic and Social Board, a Burmese cabinet group charged with general responsibilities for action on the various works projects. A former editor of CIVIL ENGINEERING, Mr. Barnes was ordered to duty with the Secretary of the Air Force shortly after the outbreak of the Korean War and participated in special studies of Air Force installations in the United Kingdom. He then served with the rank of colonel, as Director of Ground Defense for the 3rd Air Force and Director of Security in the 7th Air Division.

Donald P. Barnes

**Joseph A. Courter,** president of Courter & Co., Inc., New York, N.Y., was elected vice-president of the Building Trades Employers' Association at the organization's recent annual meeting in New York.

**Robert S. Holmes** has resigned his position as deputy director of the engineering services division of the Federal Civil Defense Administration, Washington, D.C., to assume new duties as executive assistant to the president of Wald Industries, Inc., Huntingdon, Pa.

**John W. Dixon,** director of project planning for the U.S. Bureau of Reclamation, Washington, D.C., has been assigned by the Secretary-General of the United Nations to study aspects of the utilization of Jordan water resources.

**H. P. Burrell,** for the past 16 years chief engineer for the Western Foundation Co., New York, N.Y., has been appointed to the newly-created post of special consultant to the Franki Foundation Co., of New York, Philadelphia and Pittsburgh. Major Burrell will make his headquarters in the company's New York office at 114 East 40th Street.

**Lewis B. McCammon,** until recently structural designer for C. F. Braun and Co., Alhambra, Calif., and a lecturer at the University of California, has been appointed to the staff of the Civil Engineering Department at Northwestern University. Previously he was assistant professor of civil engineering at Purdue University where he received a doctorate in structural engineering.

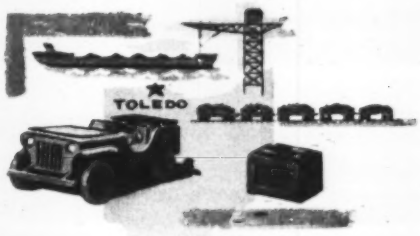
**Herman F. Bahmeier,** construction engineer for the Bureau of Reclamation at Sacramento, Calif., has gone to Australia as head of a six-man team of Bureau engineers, beginning two-year assignments to advise the government on the Snowy Mountains hydroelectric project. A 40-year veteran in the water engineering field, Mr. Bahmeier has been with the Bureau since 1930, and was last in charge of construction of the Folsom Powerplant, Nimbus Dam and Powerplant, and the Sly Park Dam. Among those accompanying Mr. Bahmeier are **Elmo C. Higginson** and **Richard B. Ward.**

**Raymond J. Rosenberger** recently resigned as head of the contract and specification department of the Cleveland branch of the J. E. Greiner Co., Baltimore, Md., to take the post of manager of a new Cleveland office for Gilbert Associates, Inc., Read-

(*Continued on page 97*)

# Toledo Prefers

# Concrete Pressure Pipe




Toledo engineers prefer concrete pressure pipe for the city's water supply mains. In 1948 an 8,600-foot installation, known as the Bancroft Street Crosstown Main, was completed. Since then 24″, 36″, 48″ and 72″ concrete pressure pipe has been used in major additions to the city's water supply system. Just recently contracts have been signed by Lucas County authorities and work is in progress on additional projects in the Toledo area, involving 16″ and 24″ pipe.

There are a number of reasons for Toledo's increasing use of concrete pressure pipe. Sustained high-carrying capacity and long life are two of the most important. Another is low maintenance cost. The original cost is also low and installation is accomplished quickly and easily.

Talk to Toledo engineers when you plan your next water line. You'll learn why they like concrete pressure pipe—not only for transmission lines, but for city distribution mains as well.

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**Concrete PRESSURE Pipe**

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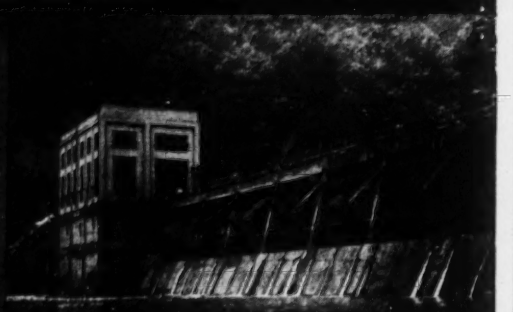
FOR CONCRETE RESTORATION



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## News of Engineers

(*Continued from page 94*)

ing Pa. Mr. Rosenberger's new address is 810 United Building, 2012 West 25th St., Cleveland, Ohio.

**Jacob L. Crane** resigned, effective March 26, as assistant to the administrator in charge of the International Housing Staff of the Housing and Home Finance Agency, in order to resume private practice in Washington, D. C., as a consulting engineer specializing in housing and city planning. Mr. Crane has been with the federal government continuously since 1938, devoting all his time to housing problems. Prior to that he had been in private practice, acting as planning and engineering consultant to 60 American cities and numerous government and international organizations. His final assignment for the HHFA was as a member of the U. S. delegation to the Tenth Inter-American Conference of the Organization of American States at Caracas, Venezuela.

Jacob L. Crane

**Henry H. Von Spreckelsen** has been appointed to the Conover-Mast publications staff as equipment development editor of "Construction Equipment." A Cooper Union engineering graduate, Mr. Von Spreckelsen has had experience in public and commercial construction with the Frederic R. Harris Co., Inc., and the Fraioli-Blum-Yesselman Co., both of New York.

**Harry L. Tooker,** structural and civil engineer for the Ambursen Engineering Corp., Houston, Tex., announces his entrance into private practice under the firm name of the Tooker Engineering Co., consulting engineers, with offices at 515 West 11th St., Houston.

**William R. Moore** has opened a consulting and sales engineering office in Madrid, Spain. He has been abroad for several years as senior engineer for CMEA, an overseas construction engineering group, with headquarters in Paris.

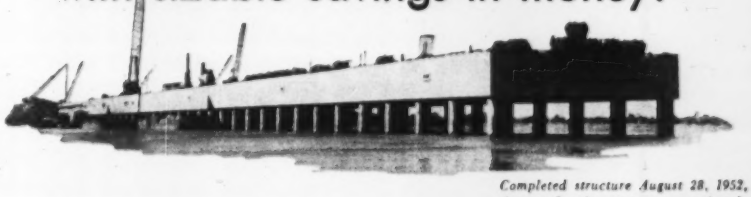
**G. Robert Koch** has joined the firm of Sanderson & Porter, engineers and constructors of New York, as hydro-engineer on the St. Lawrence River power project. He was formerly connected with Corbett, Tinghir & Co., Inc., North Bergen, N.J., as a designer of hydroelectric power plants.

**Alfred W. Maner** has been named assistant testing engineer for the Virginia State Department of Highways at Richmond. Connected with the department for several years, Mr. Maner was previously highway research engineer in the soils laboratory of the Virginia Council of Highway Investigation and Research.

**Frank L. Weaver** has been granted a leave of absence from his post as chief of the Division of River Basins, Bureau of Power, Federal Power Commission, at the request of the Hoover Commission on Organization of the Executive Branch of the Government,

(*Continued on page 98*)


**Anywhere**—in harbors or undeveloped areas—in faster time with sizable savings in money!



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**APRIL 18, 1952.**
First dock section, 82' by 377' ready for launching.
Dock sections were economically fabricated at an Orange, Texas shipyard and launched for towing to dock site.

Prefabricated to required size and strength at shipyard.

**MAY 21, 1952.**
First dock section, arriving at site on Orinoco River, after being towed across 3,000 miles of ocean.

First section loaded with its own caissons and all erection gear and equipment required for project.

**MAY 22, 1952.**
Crane placing 6 ft. diam., 100 ft. long steel caissons in wells fitted with Airjacks. Crane, Airjacks and other equipment were later transferred to second and third sections for erection purposes. Elevation of dock can be regulated to 1/32 of an inch.

After caissons are placed, De Long Airjacks working simultaneously, raise dock section to desired elevation.

A week after arrival at Orinoco Mining Company's site on the Orinoco River, Venezuela, first dock section berths ship, and unloading of cargo begins. Two additional units make this pier 1,130 ft. long, 82 ft. wide, and 15 ft. deep, shown above.

No special foundation preparation; no cofferdams. High tides, swift water no obstacle. De Long Docks can be erected under any field conditions.

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## News of Engineers

(*Continued from page 97*)

and is now acting as its special technical adviser on power on the Task Force on Water Resources and Power.

**Billings Wilson,** since 1942 director of operations and director of tunnels and bridges for the Port of New York Authority, plans to retire on July 31. Mr. Wilson, who went to the Authority in 1922, has been assistant to the chief engineer, manager of the traffic and transportation department, deputy manager, and assistant to the general manager in charge of operations and port development. In 1952, he was awarded the Distinguished Service Medal and cited as "a vital force in the successful operation of the Port of New York Authority." **Charles H. Taylor** has been named to succeed him as director of tunnels and bridges.

Billings Wilson

**Richard H. Gould** is now a member of the Chicago engineering firm, Greeley and Hansen. For the past 25 years Mr. Gould has been director of the Division of Sewage Disposal of the New York City Department of Public Works.

**Thomas G. Harton,** lieutenant colonel, U.S. Army Corps of Engineers, recently completed a tour of duty as post engineer at the Redstone Arsenal, Huntsville, Ala., and has been assigned to the Far East Command.

**W. Orme Hiltabidle,** who joined the firm of Chas. H. Tompkins Co., Washington, D.C., in 1952 following his retirement from the U.S. Navy Civil Engineering Corps, has been advanced from assistant to the president to vice-president in the company.

**Donald C. Hulbert** recently resigned as associate harbor engineer for the Port of San Diego (Calif.) to take a position with the St. John Engineering Co., North Hollywood, Calif.

**N. H. Collisson,** since 1951 general manager of the Olin Cellophane Division, Olin Industries, Inc., Pisgah Forest, N.C., has been promoted to vice-president for operations and will administer the film, paper, forest products and electrical divisions. He is former chief of the ECA mission to Germany, and special assistant to the Secretary of the Interior. During World War II, he served in the Navy for five years, advancing to captain.

N. H. Collisson

**Robert Zaborowski,** manager of the architectural and engineering branch of the New York office of Roberts & Schaefer Co., Chicago, Ill., has been appointed a vice-president of operation.

## Non-ASCE Meetings

**American Water Works Association.** The 74th annual convention of the AWWA will take place in the Seattle (Wash.) Auditorium, May 23–28.

**American Welding Society.** The American Welding Society will stage its second Welding and Allied Industry Exposition at the Memorial Auditorium, Buffalo, N.Y., May 5–7. Its national spring technical meeting will be held at the Hotel Statler in the same city, May 4–7.

**Basic Materials Conference.** The Basic Materials Exposition and Conference will be held at the International Amphitheatre, Chicago, Ill., May 17–20.

**Chi Epsilon.** A joint meeting of the Brooklyn Polytechnic Chapter and the Metropolitan New York Alumni Chapter will be held in the Civil Engineering Department of the Polytechnic Institute of Brooklyn, May 5, 7:30 p.m.

**Ninth Annual Industrial Engineering Conference.** "Creative Thinking and Techniques" will be the theme of the forthcoming Ninth Annual Industrial Engineering Conference, at the Hotel Statler, New York, N.Y., April 29–30. Co-sponsors are the Society for Advancement of Management and the American Society of Mechanical Engineers.

**Regional Technical Conference on Water Resources Development.** Under the auspices of the United Nations' Economic Commission for Asia and the Far East, a regional technical conference on water resources development will be held in Tokyo, Japan, May 17–22. A four-day technical excursion of various Japanese river basin development projects will follow the conference.

**Second Annual Conference on Road and Street Traffic Control.** The campus of Purdue University, Lafayette, Ind., will be the scene of the Second Annual Conference on Road and Street Traffic Control, April 22–23, which is jointly sponsored by the university, the Indiana section of the Institute of Traffic Engineers, and the Indiana City Engineers Association.

**Society of Automotive Engineers.** Featured at the National Aeronautics Meeting of the SAE, to be held at the Hotel Statler, New York, N.Y., April 12–15, will be an aeronautic production forum and aircraft engineering display.

**Southern Industrial Wastes Conference.** Joint sponsors of the Southern Industrial Wastes Conference at the Hotel Shamrock, Houston, Tex., April 21–23, are the Manufacturing Chemists Association, the Southern Association of Science and Industry, Inc., and the Texas Chemical Council.

**Steel Joist Institute.** Annual meeting at the Boca Raton Club, Boca Raton, Fla., May 4.

**Wire Reinforcement Institute.** Headquarters for the annual spring meeting of the Wire Reinforcement Institute, Inc., will be the Boca Raton Club, Boca Raton, Fla., May 3.


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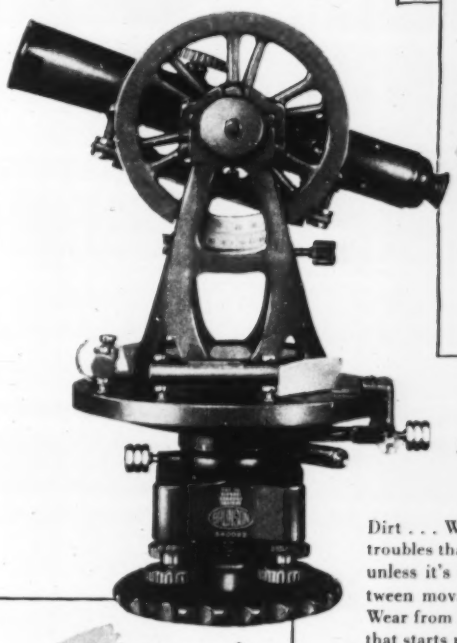
DIRT

WEAR



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# RECENT BOOKS

### Applied Elasticity

A textbook for graduate courses by Chi-Teh Wang, intended to perform two major functions: To provide the student with the necessary fundamental theoretical knowledge so that he will be able to formulate any problem occurring in the classical theory of elasticity; and to acquaint him with the most useful analytical and numerical methods for solving any such formulated problem. (McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y., 1953. 357 pp., $8.)

### Construction Methods and Machinery

In this book the principles of scientific management are applied to construction work. Part one treats planning of operations, control of work for maximum production, and economics of equipment—selection, costs, depreciation, etc. Part two discusses the fundamentals and economical utilization of machinery for power, transportation, hoisting and conveying, and pumping. In the third part—about half the book—methods of conducting specific operations are described and evaluated. F. H. Kellog is the author. (Prentice-Hall, Inc., 70 Fifth Ave., New York, N.Y., 1954. 415 pp., $10.)

### Design and Operation of Septic Tanks

Third European Seminar for Sanitary Engineers, 1952

A collection of papers on the treatment and disposal of domestic sewage in unsewered areas, with special reference to Europe. The papers, Monograph Series, No. 18, cover health considerations, design of small sewage plants, a study of the effectiveness of treatment in small plants, a review of septic tanks and small plants in Switzerland, and a comparative study of septic tanks. There is also a selective bibliography. (World Health Organization, Geneva: Available in United States from Columbia University Press, 2960 Broadway, New York 27, N.Y., 1953. 122 pp., $1.50.)

### Design in Structural Steel

With its emphasis on real structures and practical problems of design in steel, this text, by John E. Lothers, will be useful to both practicing engineers and students. It begins with consideration of structural members and connections, covers base-plates, built-up beams and plate girders, roof trusses, and industrial building bents, and concludes with a chapter on steel bridges. Many practical problems are given. (Prentice-Hall, Inc., 70 Fifth Ave., New York, N.Y., 1953. 454 pp., $10.)

### Principles of Numerical Analysis

A unified presentation that develops the mathematical principles upon which many computing

*(Continued on page 106)*

### Library Services

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CONSTRUCTION SUPERINTENDENT; A. M. ASCE; graduate and registered civil engineer; married; 46; 6 years on power plants; 15 years on airbase, papermill, warehouse depot, etc. Capable of assuming full charge 60,000 kw steam-electric plant or comparable project. C-941-832-Chicago.

ESTIMATOR-COST ENGINEER IN HEAVY CONSTRUCTION; J. M. ASCE; 34; civil engineering graduate; 5 years' office, 2 years' field, experienced in excavation, concrete and foundation work. Have done estimating, cost analysis, expediting, purchasing and closing with subcontractors. Can estimate field costs. Location preferred, New York City, Long Island and Westchester. C-942.

HYDRAULICS ENGINEER; A. M. ASCE; BSCE; 31; varied experience in municipal and utilities engineering, underwater demolition, naval administration, hydraulics research engineering. Presently French government research fellow, University of Toulouse, in hydraulics and fluid mechanics. Knowledge of French language and engineering methods. Desires permanent position with American firm, preferring France or French colonies. C-943.

CIVIL ENGINEER; J.M. ASCE; member ACSM; BSCE; 32; married; 14 years' experience in surveying and mapping including topographic mapping, property surveys, control surveys and construction surveying; supervising experience. Desires teaching job or responsible surveying position. Location preferred, West. C-944.

ENGINEER EXECUTIVE, CHIEF ENGINEER OR PROJECT ENGINEER; M. ASCE; 58; Corps of Engineers, U. S. Army 27½ years, retired 1946; executive and project engineer in charge of important work for established midwest consulting engineering firm, 7½ years. Location preferred, continental United States. C-945.

SANITARY ENGINEER; student chapter member, ASCE; 40; married; degrees in biology and civil engineering; registered. Experienced in design of sewage treatment plants, water supply systems, hydraulic and waterfront structures. Foreign assignment preferred but will consider attractive offer anywhere. Available July 1. C-946.

ARCHITECTURAL AND/OR SALES ENGINEER; J. M. ASCE; BSAE; 31; married; 5 years' experience on steel sales, design fabrication and erection. Also experienced on all phases of general construction, calling on and working with architects, engineers and contractors. Desires permanent position with responsibilities. Location preferred, Rocky Mountain region and West. C-947-522-A-6-San Francisco.

SANITARY ENGINEER; J. M. ASCE; 29; married; BSCE; engineer-in-training; 4 years' experience in public health engineering, industrial wastes treatment, recovery, control, by-products production and plant sanitation. Requires responsible position with future; prefers industrial or limited sales position commensurate with experience. C-948.

CIVIL ENGINEER; J.M. ASCE; 23; single; BSCE 1952; 16 months' construction and administration with aviation engineers in Alaska. Available in April upon release from Corps of Engineers, U. S. Army. Desires responsible work in construction and/or design. Location preferred, Northeast. C-949.

## Positions Available

MANAGING EDITOR for civil engineering publication, under 30, civil engineering degree. Will be responsible for conceiving, developing and programming as well as editing. Will carry out a college promotion program with 140 civil engineering colleges, including exhibits, and teaching aids such as manuals, handbooks and information for speeches. Location, Midwest. Y-9218.

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payment reviews, and also to interpret property tax laws, court decisions and administrative rulings. Some traveling. Salary, $5,000 a year. Location, New York, N.Y. Y-9298.

CIVIL ENGINEER with sanitary engineering experience covering water works, pipelines or municipal engineering for water waste surveys and distribution studies of municipal water systems. Salary open. Locations, United States and Canada. Y-9478.

SANITARY ENGINEER, licensed or eligible for examination for license to practice professional engineering in New York State. Degree in sanitary or public health engineering and 4 years' public health engineering experience; or, degree in civil or chemical engineering and 6 years' public health engineering experience; or, any combination of education, experience and training which is determined to be the equivalent of either of the above. Location, New York State. Y-9497.

ARCHITECTURAL ENGINEER, 40–45, 15 years' minimum experience in building construction as engineering designer and building architect. Should have BS degree in architecture, architectural engineering, or civil engineering. Should be registered architect with knowledge of building engineering, design, construction and alteration. Drafting plans and setting up specifications. Coordination and direction of construction work. Salary open. Location, New Jersey. Y-9562.

STRUCTURAL ENGINEER, about 40, professional CE license in New York State; must have experience in structural steel fabrication and erection. Salary, $9,000–$10,000 a year. Location, New York State. Y-9644.

ENGINEERS. (*a*) Sanitary Engineer, graduate, with experience in sanitary, civil or public health engineering. Must be registered engineer, or eligible for registration in State of Vermont. Will conduct investigations and inspections on such problems as condition of water supplies, treatment of sewage, the extent of stream and lake pollution, etc. Conduct research and surveys on sanitation problems; advise and consult with city and town officials, etc. Salary, $3,354–$5,044 a year depending on training and experience. (*b*) Industrial Hygiene Engineer, graduate, experienced in the field of industrial hygiene. Must be registered engineer. Will organize and conduct difficult engineering studies and investigations in the field of industrial hygiene and perform related work; make inspections of industrial plants; prepare reports; make recommendations, etc. Salary, $3,354–$5,044 a year depending on training and experience. Location, Vermont. Y-9724.

TEACHING PERSONNEL. (*a*) Professor in civil engineering. Duties involve teaching structural design in concrete, steel and timber and mechanics of materials. Desire registered professional engineer associated with ASCE. Salary open. Starts September 1954. (*b*) Professor in civil engineering to teach surveying, soil and fluid mechanics, statics, and highways. Registered professional engineer desired. Salary open. Starts September 1954. Location, Ohio. Y-9733.

CIVIL OR STRUCTURAL ENGINEERS, recent graduates or with practical experience in structural design work, for company engaged in the design of steam electric power plants and industrial developments, including test facilities for jet engines. Work involves determining general structural requirements, including site development, interior layouts, foundations and building superstructure. Prepares working drawings, specifications and estimates for these projects. Salary open. Location, Massachusetts. Y-9757.

CITY ENGINEER, capable of assuming all the duties and responsibilities of municipal engineering. Location, Texas. Y-9762.

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ENGINEERS. (*a*) Party Chiefs, to establish accurate control lines and points, computing and stake out of highway curves, etc. Salary, $5,400–$6,000 a year. (*b*) Instrument men experienced in the operating of transits and levels on all survey work related to super highway and turnpike design and construction. Salary, $4,500–$4,800 a year. (*c*) Rodmen and/or Chainmen experienced in the use of plumb bob and tension scale in making accurate measurements. Salary, $3,420–$3,780 a year. (*d*) Highway Draftsmen experienced in highway drafting work including alignment, topography, drainage structures, detailing, computations, plotting cross-sections, etc. Salary, $3,952–$4,472 a year. Locations, Florida, Connecticut, Kentucky or Indiana. Y-9774.

INSTRUCTOR IN MECHANICS. BS degree, under 30. No experience required. Knowledge of undergraduate statics, dynamics, strength of materials, fluid mechanics. Beginning September 1954, to teach undergraduate courses in statics, dynamics, strength of materials, fluid mechanics and to engage in research if available. Opportunity to work toward advanced degree. Salary may be augmented by summer teaching. Salary, $3,500–$4,000 for 9 months. Location, Chicago. C-1699.


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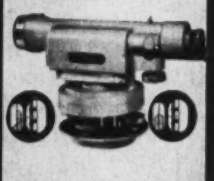

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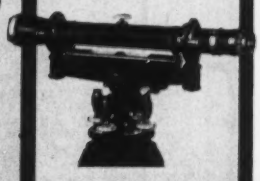

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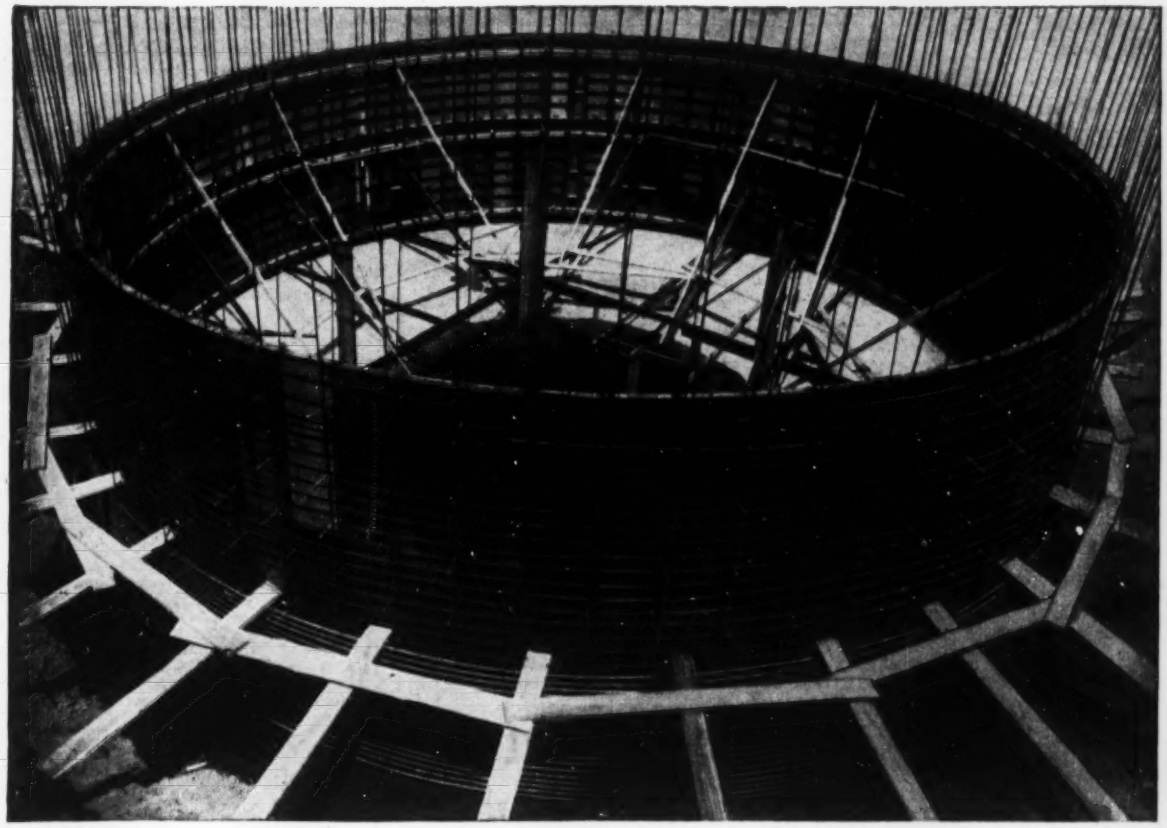

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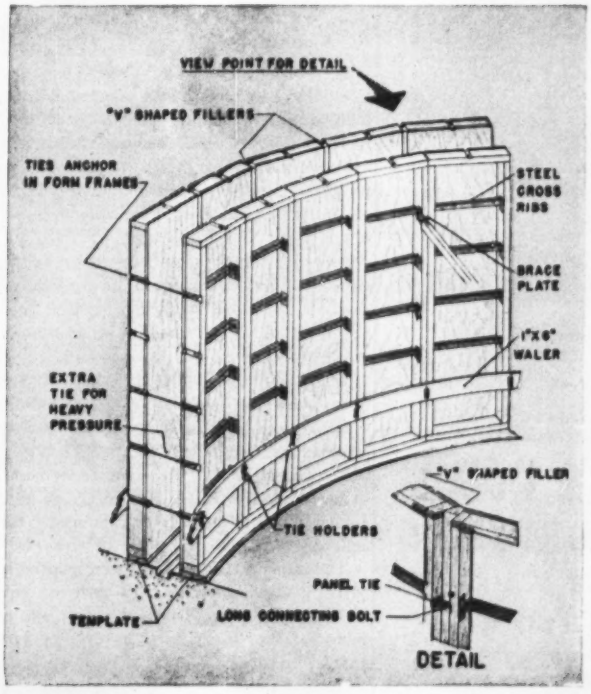


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## Recent Books

(*Continued from page 100*)

methods are based. Directed primarily toward high-speed digital computation, the book also contains much useful material for "hand" computation. The author, Alston S. Householder, covers specifically matrices and linear equations, nonlinear equations, interpolation and other approximations, and the Monte Carlo method. (McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N.Y. 1953. 374 pp., $6.)

### Proceedings of 1953 Conference on Nuclear Engineering

University of California, Berkeley, September 9–11, 1953

Thirty-three contributed papers on nuclear power are reprinted under the following subject groups: Reactors—power and research; equipment for neutron research; nuclear power-plant economics; nuclear kinetics, instrumentation, and control; materials for reactor components; accelerator engineering; uses of isotopes and nuclear radiations. Two special papers deal with a nuclear-power program and metals for reactor-core construction. (California Book Co., Ltd., 2310 Telegraph Ave., Berkeley 4, Calif., 1953. $7.50.)

### Formulas for Stress and Strain

A working handbook for machine and structural designers by Raymond J. Roark which summarizes formulas, facts and principles relating to strength of materials. Parts I and II cover definitions and symbols, general principles, methods of stress analysis, and the behavior of materials under stress. Part III, the major section, describes in detail the behavior of structural elements under various conditions of loading, with extensive tables of formulas for calculating stress, strain, and strength. In this edition, new data have been added throughout. (McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y., third edition, 1954. 381 pp., $7.50.)

### Welding Engineering

Boniface E. Rossi, the author, provides a comprehensive survey of welding engineering fundamentals for the student or beginner and a wider understanding for those now in the field. It can also be used as a reference manual by engineers, designers and others. The four main sections of the book cover welding processes, metals and their weldability, design and fabrication considerations, and testing and inspection of welds. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y., 1953. 786 pp., $8.)

### Theory and Practice of Structural Design Applied to Reinforced Concrete

The matter and arrangement of this book by B. Eriksen are intended primarily to enable students to apply the principles of statics and the theory of elasticity to the design of structures for which formulas are not available. Part I is concerned with fundamental considerations and statically-determinate structures; Part II, with statically-indeterminate structures. Actual design procedure for a 90-ft. portal frame bridge is appended. (Concrete Publications Ltd., London, 1953. 401 pp., $5.50.)

### The Design of Dams

Part I of this translation by Frank E. Fergusson from the French is an introductory summary of the basic formulas and theories. Part II is a thorough exposition of the well-established design procedure for gravity dams. Part III discusses in considerable detail the mainly theoretical methods of design of arch dams; and Part IV deals briefly with counterfort and hollow dams. Extensively illustrated by diagrams and graphs. The author is A. Bourgin. (Sir Isaac Pitman & Sons, Ltd., London: Available in U.S. from Pitman Publishing Corp., 2 West 45th St., New York, 19, N.Y., 1953. 344 pp., $8.50.)


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### Solution to problem on page 72

Reinforced concrete was selected for the high-pressure pipeline, principally because more man-hours would be employed in the construction. Since this was one of the projects partially financed by the Puerto Rican Reconstruction Administration, as much work as possible was given to the people living in the area. One other factor considered was the expected life of the pipeline. It was determined at that time that the duration of steel would be only approximately ten years.

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## Positions Announced

**UNESCO.** Posts in the general categories of science, engineering, and education are frequently available in the UNESCO Program of Technical Assistance. At the present time there are openings for an expert in technical education in Djakarta, Indonesia, and a hydrologist in Mexico. Applications for these posts or for additional information should be addressed to the Technical Assistance Unit, UNESCO, United Nations, New York 17, N.Y.

## Applications for Admission to ASCE, February 27–March 6

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LINN CARL BIERMAN, Harrisburg, Pa.
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HOWARD CARL BROWNE, St. Louis, Mo.
HENRY CAMPBELL, Kingston, R.I.
NORMAN JOCELYN DIGNUM, Miami, Fla.
MIRZA MOHAMMED DIN, Bombay, India.
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RUSSELL HARVEY, Columbus, Ohio.
JAMES RIDER HAYDEN, Tallahassee, Fla.
WARREN ROSECRANS HEDDEN, Chicago, Ill.
HARALD HENRY ZUR NIEDEN, Pasadena, Calif.
JACOB ERNEST HILL, Boise, Idaho.
HENRY LATHROP, St. Albans, W. Va.
JOEL RICHARD LEWIS, Honolulu, T.H.
MURALIDHAR ROY, Bihar, India.
ALFRED H. SAMBORN, Toledo, Ohio.
CARL ARTHUR SIVERTSON, Duluth, Minn.
RUSSELL CROM STANTON, Augusta, Ga.
SAMUEL DAVIS STURGIS, JR., Washington, D.C.
PETE WARD TERRELL, Denver, Colo.
HAROLD ALLEN THOMAS, JR., Cambridge, Mass.
WALTER JAMES WEYERMANN, Zurich, Switzerland.
HARLAN FRANK WINN, Washington, D.C.

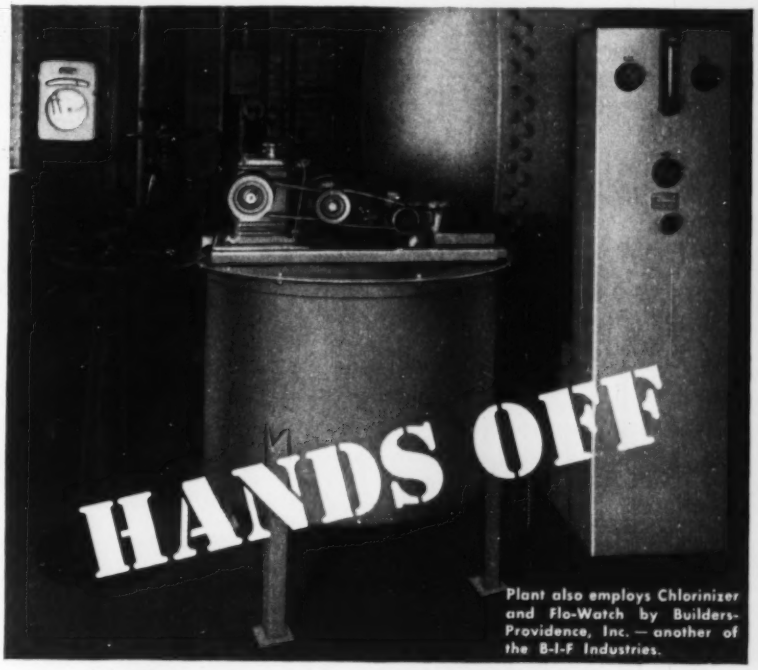
### Applying for Associate Member

MOHAMMED ALI SAJANLAL, Karachi, Pakistan.
EDWARD CHARLES BAKER, Cleveland, Ohio.
WILLIAM JOSEPH BLANTON, Richmond, Va.
IVAN PEKOW BUBBOW, Johannesburg, S. Africa.
ALBERT NEILL CAMERON, Atlanta, Ga.
JAMES GEORGE CASSANOS, Dhahran, Saudi Arabia.
JOHN VANN EBERLEIN, JR., Mobile, Ala.
JOSEPH ALFRED FINELLI, Oakland, Calif.
CRESTON EADER FUNK, Cleveland, Ohio.
JOHN TRACY GAFFEY, II, San Francisco, Calif.
RAYMOND FREDERICK GODDARD, Detroit, Mich.
HAROLD CHRISTIAN GREEN, Sacramento, Calif.
KENNETH EDWARD GREENE, San Francisco, Calif.
EDWARD ANSON HENDERSON, Trenton, N.J.
AUSTIN HOGAN, Peekskill, N.Y.
YUICHI IWAGAKI, Kyoto, Japan.
HERMAN EDWARD KENDALL, Portland, Me.
RALPH FRANKLIN KRESGE, Washington, D.C.
LAVERNE DAVIDSON LEEPER, Alhambra, Calif.
THOMAS RICHARD LEONHARDT, Toledo, Ohio.
GEORGE TERRENCE MAHONEY, Kansas City, Mo.
THEODORE EDWIN MANN, Chester, Mont.
ROBERT LAWRENCE PFEIFER, West Allis, Wis.
ABDUR RASHID, Lahore, Pakistan.
LEO STRAUS, Dayton, Ohio.
DAVID OWEN VAN STRIEN, East Lansing, Mich.
THOMAS DUDLEY WARD, Midland, Tex.
LEE WILLIAMS, Atlanta, Ga.
LESLIE CAMPBELL WILSON, Johannesburg, South Africa.
ALEXANDER SHIH HAN YU, New York, N.Y.

### Applying for Junior Member

ALFONSO ACOSTA-LLERAS, Bogota, Colombia.
WILLIAM MAXWELL ALEXANDER, Birmingham, Ala.
LEONARD BUSH BALDWIN, JR., Moscow, Idaho.
SANFORD NORMAN BELKIN, St. Louis, Mo.
WILLIAM EDWIN BLAKESLEY, Oceanside, Calif.
ROBERT J. BRUNGRABER, New York, N.Y.
JOHN HAROLD BURNESON, Overland, Mo.
JACK HAZEN CARLSON, Tifton, Ga.
PANNALAL CHHAGANLAL SHAH, New Haven, Conn.
ANDREW BERNARD CLEMENT, Ft. Belvoir, Va.
ROBERT DANIEL DARRAGH, JR., Pasadena, Calif.
LEONARD ARIE DEGAST, Washington, D.C.
JOHN HENRY DIXON, Jacksonville, Fla.
JOHN EFTIS, Newark, N.J.
MARK BERGMANN FOSS, Grand Forks, N. Dak.
JARVIS JENNESS GATES, San Francisco, Calif.
VICTOR BERNHARD HALLBERG, North Haven, Conn.
FRANK JOSEPH HEGER, JR., New York, N.Y.
ROE PALMER HENDRICK, Providence, R.I.
CARL HAROLD HOLM, New York, N.Y.
OTIS ARTHUR HUDSON, JR., Loma Linda, Calif.
MERWYN OSBORN HUNTRESS, JR., City of Oklahoma, Okla.
LEONARD HOWARD KAHAN, Chicago, Ill.
FAREED KHOURSHEED, Rochester, Pa.
ANDERS BENGT LARSSON, Grosse Pointe, Mich.
THEODORE LEASK, Hammond, Ind.
HOWARD GEORGE MINCKLER, Swarthmore, Pa.
ROGER EUGENIO NAVA, Iowa City, Iowa.
RICHARD WILLIAM NEWELL, Gadsden, Ala.
REYMOND LOUIS NORDLUND, Urbana, Ill.
JOHN EDWARD OLSSON, Lincoln, Nebr.
SHANTILAL CHATURBHAI PATEL, East Lansing, Mich.
FREDERICK R. POKORNY, JR., New York, N.Y.
PUNJA MULKI RAMANATH, Harrisburg, Pa.
THOMAS FREDERICK REGAN, Wichita, Kans.
RICHARD ROLLIN REINSCH, Rogersville, Tenn.
ALAM SINGH, Jodhpur, India.
BOGOS TORIKOGLU, Austin, Tex.
GUIDO VON AUTENRIED, New York, N.Y.
ARLINGTON WAGGONER, JR., Little Rock, Ark.
VINCENT ALEXANDER WIENSKI, Chicago, Ill.
LEON WINTERS, New York, N.Y.
ANDREAS NIKLAUS ZWALD, San Francisco, Calif.

*[Applications for Junior membership from ASCE Student Chapters are not listed.]*

Plant also employs Chlorinizer and Flo-Watch by Builders-Providence, Inc. — another of the B-I-F Industries.

PROPORTIONEERS
Corrosion Control at Work

This new Proportioneers lime slurry feeding package featuring a classifying draft tube solves the complete corrosion control problem for the Jamestown Water Company in Jamestown, Rhode Island — and does the job PRACTICALLY WITHOUT ANY OPERATOR ATTENTION WHATSOEVER. It's a simple unit — a Proportioneers Heavy Duty Chem-O-Feeder mounted on an agitator-equipped tank. The milk of lime is injected into the effluent from pressure filters against a pressure of 85 p.s.i. The complete package is self-cleaning, and practically self-operating, and includes safety features which insure against failure or clogging.

Solve your chemical feeding problems with a Proportioneers equipment package. Send details for data and recommendations. Proportioneers, Inc. 360 Harris Ave., Providence 1, R. I.

PROPORTIONEERS
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • BUILDERS PROVIDENCE, INC. • OMEGA MACHINE CO.
METERS FEEDERS CONTROLS

# CATALOG DIGESTS of ENGINEERING and INDUSTRIAL interest

### 1 AERIAL CONVEYORS

**Sauerman Bros., Inc.**—Sixteen pages of photographs, sketches, and text describe types, spans, working loads and other details of tautline cableways. This new 3-color catalog illustrates cableway applications that will be of interest to civil and consulting engineers, public utilities and industrial concerns.

### 2 AERIAL MAPPING

**Aero Service Corporation**—Offers catalogs or literature covering new and more economical applications of varied aerial mapping services. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, airborne magnetometer surveys for ore and oil, and both plastic and plaster relief maps. Services discussed are used in highway design, plant engineering, industrial development, community planning, geological explorations and prospecting for oil or minerals.

### 3 AERIAL SURVEY AND MAPPING METHODS

**Fairchild Aerial Surveys, Inc.**—Aerial Survey and Mapping methods—particularly in relation to engineering and planning problems are described and illustrated in "Focusing on Facts," available when requested on your business letterhead.

### 4 AIR-ENTRAINED CONCRETE

**Autolene Lubricants Company**—A new and enlarged edition of the Protex Modern Placement of Concrete fact book, has been recently announced. Published under the direction of Autolene Industrial Research Division, the edition contains the latest technical information and field use on air-entrained concrete. Complete with photographs of the latest concrete construction projects, the book is full of questions and answer information about air-entrainment technique and Protex Air-entraining solutions.

### 5 AIR METER CATALOG

**Autolene Lubricants Company**—A new, revised edition of the Protex Air Meter Catalog has just been released. The catalog, published under the direction of the Autolene Industrial Research Division, describes the use of a meter in the placement of air-entrained concrete. A full description of the Protex Air Meter, its operation, and benefits of accurate control are given.

### 6 AIR POLLUTION SURVEY METER

**Taller & Cooper, Inc.**—Has announced a new, portable carbon monoxide detector, sensitive to 50 parts per billion of carbon monoxide in air with full scale ranges of 1, 10, 100 and 200 parts per million selected by a simple range switch. The unit, 15 × 15 × 9 in. in size, and weighing about 75 lbs, contains its own sampling pump and plugs in to 115 volts A.C. power supply. A simple turn of a dial converts the unit into a mercury-vapor detector.

### 7 AIR RELEASE AND INLET VALVE

**Simplex Valve & Meter Company**—Bulletin 1203, 4 pages, describes functions of the Type AV Combination Air Release and Air Inlet Valve. This valve is designed for the purpose of providing a small device having the functions of releasing automatically air accumulations from systems, admitting air to systems for the purpose of breaking vacuums within them and venting large quantities of air when filling systems with water.

### 8 ARC WELDING

**The Lincoln Electric Company**—Offers studies in structural arc welding, issued periodically; current series presents an analysis of the design of a welded rigid frame building, typical of design used for warehouses, plants, churches, auditoriums, markets, etc. Building is 60 ft by 150 ft, 24 ft high at the center. Design is flexible as to size of building and is unusual in that metal roof decking is used to give longitudinal rigidity without the aid of auxiliary purlins. Comparative analysis made to illustrate advantages.

### 9 ASPHALT PLANT CATALOG

**Barber-Greene Company**—A 36-page two-color catalog describes the Barber-Greene 848 Series of asphalt plants and their components. There is a flow chart of a high-type asphalt plant showing the various functions of each component unit relative to the overall plant operations. All types of asphalt plant set-ups are featured, such as: cold aggregate controlled, stabilization, travel plant, etc. Feeders, hoppers, gradation unit, mixer, dust collector, and dryer are described and illustrated as individual units as well as their numerous combinations.

### 10 AUTOMATIC RECORDING ALTIMETER

**Wallace & Tiernan Incorporated**—Has announced a new automatic unit which periodically records surveying altimeter readings on 35mm. film. The unit, known as the W & T Alticorder, will operate continuously and without attention for seven days. It eliminates the need for taking altimeter readings manually at base stations. Designed primarily with an eye on the economics of topographic mapping, the Alticorder can completely recover its cost within 100 days accumulative use. Detailed information on the unit is now available.

### 11 BELT CONVEYOR IDLERS

**Link-Belt Company**—Covers more than 500 belt conveyor idlers, in 34 types, in Book No. 2416. Idlers of the 20 degree troughing type for light, medium and heavy duty service, two styles of 45 degree idlers, flat belt, belt training, rubber cushion and variable troughing idlers are shown, all in a broad range of roll diameters and belt widths, together with return belt idlers. Detailed information is provided for selection and spacing, based on weight and lump size of material to be conveyed.

### 12 BITUMINOUS FINISHER

**Barber-Greene Company**—The 879-A bituminous finisher, which for years has been the standard for laying bituminous surfaces, has added a stone laying kit to their list of accessories. With this kit the finisher can be adapted for laying up to 4 in. maximum stone for base and sub-base work. The needs of the field for this type of equipment has helped B-G to adapt the finisher to this difficult task. This bulletin gives the advantages, limitations, specifications, and quotes field reports on the efficiency of the new kit for Barber-Greene's bituminous finisher.

## Mail This COUPON To-day

**CIVIL ENGINEERING** Date.....
**33 West 39th St., New York 18, N. Y.**

Please have the literature indicated by the circled Catalog Digest numbers in the April 1954 issue sent to me without obligation.

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34* | 35* | 36 | 37* | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
| 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 |
| 76 | 77* | 78 | 79 | 80 | 81* | 82 | 83 | 84 | 85* | 86 | 87 | 88 | 89 | 90 |
| 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103* | 104 | 105 |
| 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 |
| 121 | 122 | 123* | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 |
| 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 |
| 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 |
| 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 |
| 181 | 182* | 183 | 184 | 185 | 186 | | | | | | | | | |

*There are charges for items Nos. 34, 35, 37, 81, 85, 123, and 182. See Notes below these items.

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**NOT GOOD AFTER April 15, 1954, for readers in the U.S., but requests will be accepted to June 30, 1954, from readers outside of this country.**

## Use This Free Service—Mail The Coupon To-day

## CATALOG DIGESTS

### 13 BITUMULS—TYPES AND USES

**American Bitumuls & Asphalt Company**—Has a 24-page, two color booklet, "Bitumuls for Maintenance" which is a fully-illustrated, valuable guide to modern methods, materials and equipment for the repair and maintenance of existing pavements. It covers the use of various types of emulsified asphalts with a wide range of aggregates.

### 14 BOILERS AND STOKERS

**The James Leffel & Co.**—Offers Boiler Bulletin 236 describing completely the 17 sizes of Scotch Marine Type Boilers and Leffel Underfeed Stokers. The bulletin contains full information on boiler construction, care and factors of performance.

### 15 BORINGS

**Raymond Concrete Pile Co.**—A booklet "Subsoil Investigations for Foundations," catalog B-4, explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

### 16 BRONZE CASTING ALLOYS

**American Manganese Bronze Company**—A 48-page booklet, called "Reference Book on Bronze Casting Alloys," gives general information on composition, characteristics, and applications of many of the common or typical alloys. It has an index of specifications for common kinds of bronze castings; and an index of applications and characteristics of bronze alloys in cast form.

### 17 BULK MATERIALS HANDLING

**Sauerman Bros., Inc.**—Catalog E describes various systems for handling bulk materials in and out of storage with drag scraper and other machines operated by one man for any desired capacity. The drag scraper picks up material, reclaims or stocks out, dumps, without use of any supplementary equipment, works over longer spans.

### 18 BUSINESS AND TECHNICAL GUIDE

**McGraw-Hill Book Co.**—Offers a special catalog devoted to recent publications covering various phases of civil engineering. Complete, clear descriptions are given on books dealing with hydraulics, cost estimation, concrete, foundations and structures, soil mechanics, mathematics and allied subjects. Written by experts in the field, these books contain the facts, experience, data needed in solving your particular problems.

### 19 CAPITAL FORMS

**The Denform Company**—Offers a bulletin illustrating an easy-to-handle, reusable capital form which will speed up forming on all round column and capital construction. Designed for use with Sonotubes, it is quickly adjustable to every standard Sonotube diameter. Each Denform is composed of a drop head ring at the top, intermediate forming rings and a seating ring at the bottom, ready for use, completely assembled.

### 20 CAST-IN-PLACE PILES

**Eastern Concrete Pile Co., Div. of C. L. Guild Construction Co., Inc.**—Has a descriptive folder on the COBI cast-in-place concrete piles. It illustrates how the piles are driven, poured, and tested. The corrugated spiral shell is driven by a pneumatic mandrel expanded with 125 psi pressure. The company points out that the piles screw themselves into the ground, resisting both settlement and uplift. Another folder is available, which describes the use of the COBI pile on the New York Thruway.


# There are 120 miles of pressure-creosoted piles under this grain elevator

Elevator A, Atchison, Topeka and Santa Fe Railway System, Argentine, Kansas.

• Construction of Elevator A of the Atchison, Topeka and Santa Fe Railway System at Argentine, Kansas, began back in 1905. Completed in 1931, it is today the second largest grain elevator in the world, with a capacity of over 10 million bushels. Pressure-Creosoted Foundation Piles — 23,142 of them — support the huge structure. Each of the 30-to-35 foot piles was designed to carry up to a 20 ton load.

Engineering firms throughout the country have found that they can rely on Pressure-Creosoted Foundation Piles for strength, permanency, and low cost. Creosote, driven deep into the cell structure of the wood, thoroughly protects these piles from decay and termite attack. And there is no chance for the creosote to evaporate. The piles are completely smothered by earth and concrete caps.

Approved by the A. S. A. and other major Building Codes, Pressure-Creosoted Foundation Piles are classified as permanent construction when cut off above the water table, and tops saturated with creosote and capped in concrete. For information on price and delivery, please write to:

**KOPPERS COMPANY, INC.**

KOPPERS PRESSURE-TREATED WOOD

**Wood Preserving Division, Pittsburgh 19, Pennsylvania**

## Automatic Water Control Gates

CONTROLS WATER LEVELS AUTOMATICALLY

Developed in France, proven in North Africa, U.S. irrigation and power companies report this gate unequaled to control water levels, assure equitable distribution, 24 hours a day in canals, reservoirs, forebays, etc.

Entirely self operating . . . saves cost of gate keeper . . . prevents costly washouts and flood damage.

There may be an installation near you for inspection. Write for information.

## *Accurate* Parshall Measuring Flumes

Accurately measures water in open ditches and canals, regardless of water velocity. Ideal for sewerage and water treatment plants. Settles water disputes.

Self cleaning . . . easy to read. Built of corrosion-resistant galvanized steel for long life. Approved by state engineers. Write for details and prices.

**MAIL TODAY**

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**3017 Larimer Street, Denver 1, Colorado**

Gentlemen: Please send me without obligation pictures and data on water control equipment.

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Address_____

City_____ State_____

**THOMPSON PIPE & STEEL COMPANY**


# CATALOG DIGESTS

### 21 CEMENT GUN

**Cement Gun Company, Inc.**—Of considerable interest to the engineering profession is a 65-page booklet, designated as Bulletin 2400, describing the cement gun and its applications. It covers the principal uses of "Gunite" and is profusely illustrated. In the last few pages of this bulletin are typical specifications for various types of "Gunite" work.

### 22 CHEMICAL FEEDER

**%Proportioneers, Inc.%**—New Bulletin 1910-1 describes a low capacity chemical feeder known as the "Chlor-O-Mite." It is a compact electrically operated diaphragm type feeder. Specifically designed for controlled feeding of Hypochlorite or water treating chemical solutions into small water systems, operating at not over 50 gallons per minute and 50 pounds per square inch pressure. All parts needed for the complete installation are furnished as a kit.

### 23 CLARIFIERS

**Infilco Inc.**—Bulletin 850-A describes how the "Cyclator" is designed to combine in one unit all functions, both chemical and physical, for complete treatment of a wide range of industrial wastes, especially those containing large amounts of light suspended solids or those which produce voluminous sludges.

### 24 CONCRETE

**The Master Builders Co.**—A 12-page booklet entitled, "A Quiz On Concrete," shows by means of charts and data why Pozzolith, cement-dispersing, water-reducing, air-entraining agent is a positive aid in obtaining: required strength most economically; required workability most economically; minimum shrinkage; low permeability; maximum bond of concrete to steel; and maximum durability. It also gives suggestion specifications for concrete.

### 25 CONCRETE ADMIX

**American Bitumuls & Asphalt Company**—A 4-page leaflet, "Pittsburgh Testing Laboratory Report on Hydropel, An Integral Admix for Waterproofing Concrete" as compared to other admixes is offered. Reproductions of the actual test reports from this independent laboratory, combined with explanatory graphs, charts, photographs and summaries, show the superiority of Hydropel concrete in resistance to water absorption.

### 26 CONCRETE COLUMNS

**Sonoco Products Co.**—Has a detailed booklet containing design data for reinforced concrete columns from 8 in. to 36 in. ID. Also available, technical data on Sonotube fiber forms for circular concrete columns and piers.

### 27 CONCRETE CONSTRUCTION ACCESSORIES

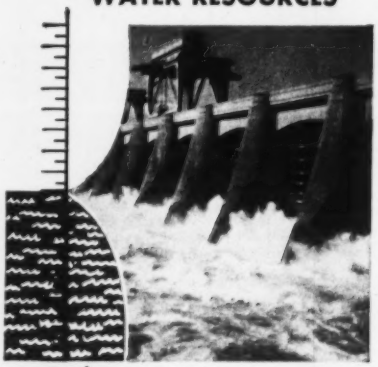
**Superior Concrete Accessories, Inc.**—Catalog 500 has 56 pages on accessories for concrete construction. Form ties and clamps are grouped by class of construction; for ordinary foundations, for water tight walls, for engineering structures and tilt up slab construction. There is also a section devoted to special products often required in concrete construction. Tables of concrete pressures in forms at summer and winter temperatures, recommended safe spacings of form ties grouped by sizes of form lumber and safe tie capacities are given in an insert at the back of this catalog.

### 28 CONCRETE CURING COMPOUNDS

**Hunt Process Co., Inc.**—Offers a bulletin illustrating four uses of the Hunt Process. Shown in details are the Hunt Process "Clear", for natural color of the concrete; "Tilt-Up", for curing and bond breaking in "tilt-up" or precast construction; "Black", for curing and waterproofing; and "Pigmented-White & Gray", for temperature control in the concrete. Specifications will be furnished upon request.


## BASIC DATA

**FOR UTILIZING WATER RESOURCES**



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**graphic, visual or audible registration . . . local or remote**

The planning of any project which involves the utilization of water resources is based on flow data which can be obtained from STEVENS water level recorders. And STEVENS recorders are equally important in the efficient operation of the completed project.

STEVENS instruments have been a standard of quality since 1907. They are at work compiling data on all major hydroelectric and flood control projects, and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

**Consult with STEVENS hydraulic instrument specialists before planning any water measurement or control installation.**

**STEVEN'S *Data Book***

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Puts interpretive data at your finger tips. 144 pages of technical data . . . information on float wells and recorder installations . . . a wealth of hydraulic tables and conversion tables.

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## MAYO

### PNEUMATIC GROUTER and "PEA SHOOTER"

The Mayo Pneumatic Grouter has performed capably on jobs ranging from tunnels, mines, and shafts to foundations and railroad subgrades. Simple and efficient in operation, it may also be used for injecting chemical soil stabilizers into caving or running ground.

For grouting back of lagging in rock tunnels or back of liner plates in soft ground, the Mayo Grouter is readily converted to a "Pea Shooter" for shooting Pea or "Bird's Eye" gravel.

The Mayo Pneumatic Grouter has no moving parts within the Grout . . . gives years of trouble-free service. Shop tested to twice working pressure. Capacity: 3½ cu. ft., charging height: 3 ft. Weighs approximately 700 lbs., and occupies 22 cu. ft. space.

*For complete details and specifications, write for Free Bulletin 13*

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Steel Forms
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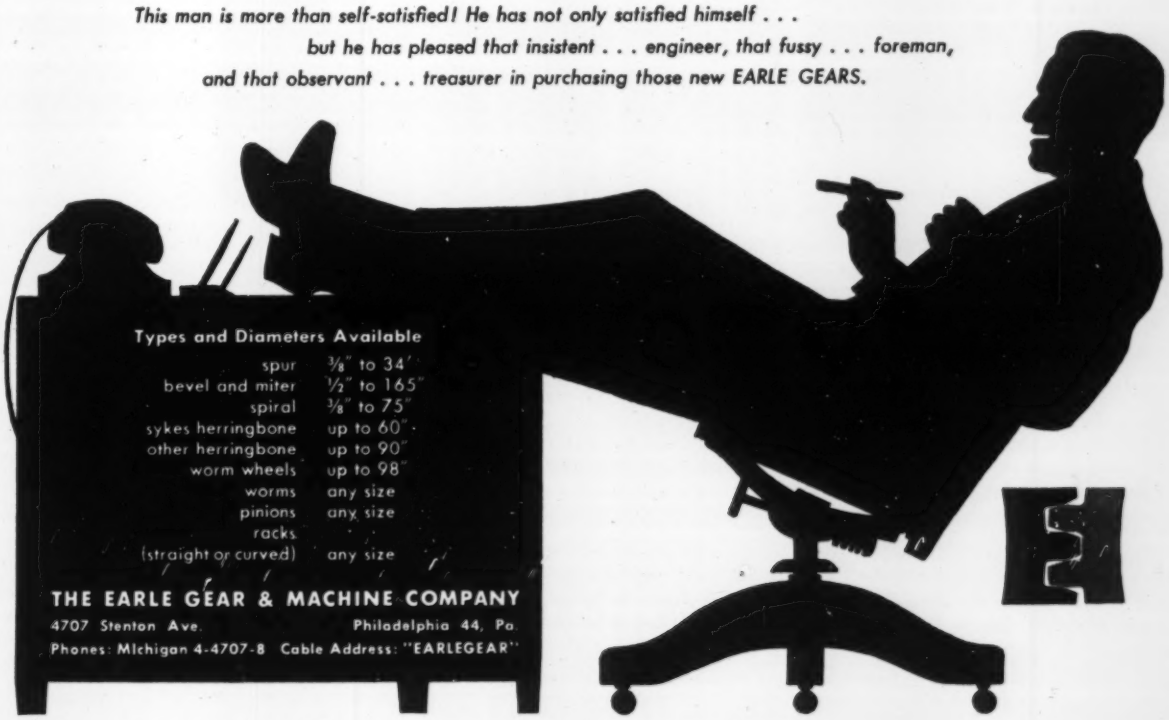
## *For happy, easy-chair satisfaction, specify EARLE GEARS*

*This man is more than self-satisfied! He has not only satisfied himself . . . but he has pleased that insistent . . . engineer, that fussy . . . foreman, and that observant . . . treasurer in purchasing those new EARLE GEARS.*



**Types and Diameters Available**

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| spur | ⅜" to 34' |
| bevel and miter | ½" to 165" |
| spiral | ⅜" to 75" |
| sykes herringbone | up to 60" |
| other herringbone | up to 90" |
| worm wheels | up to 98" |
| worms | any size |
| pinions | any size |
| racks (straight or curved) | any size |

THE EARLE GEAR & MACHINE COMPANY
4707 Stenton Ave. Philadelphia 44, Pa.
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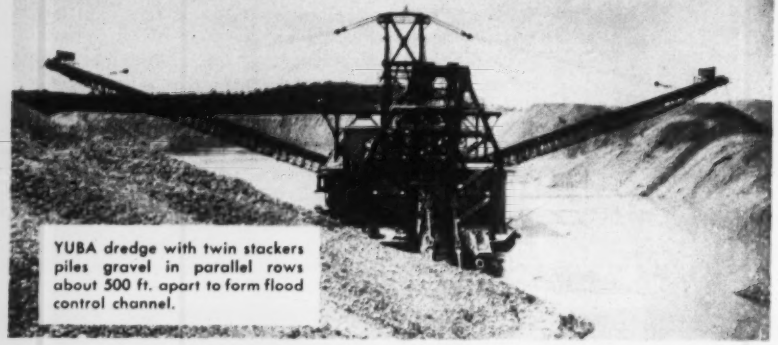
# YUBA DREDGES ON ENGINEERING CONSTRUCTION



YUBA dredge with twin stackers piles gravel in parallel rows about 500 ft. apart to form flood control channel.

ARE YOU PLANNING TO

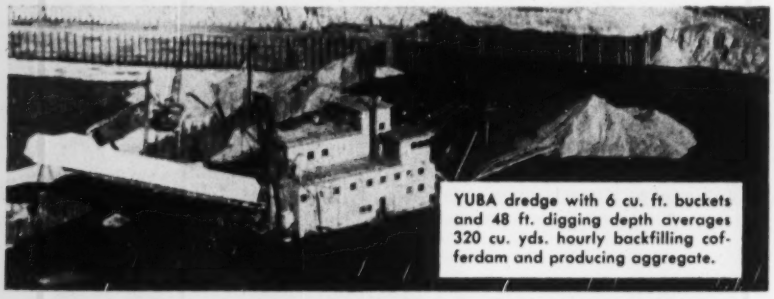
- Erect flood control levees?
- Change stream channel?
- Deepen harbors or ship channels?
- Construct canals or cofferdams?
- Dig and stock pile aggregate?
- Mine rare earths, precious metals, industrial minerals?

. . . then a YUBA bucket ladder dredge can be both feasible and profitable for the job. Case histories of over 40 years of operation prove that bucket ladder dredges, properly designed, can move huge quantities of alluvial material at low cost per yard. In heavy, rough materials (cemented gravel, bedrock, boulders, coral) weight of bucket increases efficiency of cutting edge; enables you to dig without costly drilling and blasting.

## DIGGING DEPTHS AND BUCKET SIZES

YUBA dredges have been built for digging depths to 124 feet below water level and for working against a bank face of 50 feet. Bucket sizes from 2½ cu. ft. to 18 cu. ft. or larger.

YUBA will design and build a new dredge to fit your ground; or help you find a used dredge, and move, redesign and rebuild it. Investigate the profit potentialities of YUBA dredges for construction NOW. Wire, write, or call us—no obligation, of course.



YUBA dredge with 6 cu. ft. buckets and 48 ft. digging depth averages 320 cu. yds. hourly backfilling cofferdam and producing aggregate.

YUBA DREDGES — IMPROVED

**YUBA MANUFACTURING CO.**

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49


# CATALOG DIGESTS

### 29 CONCRETE DENSIFIER

**Sika Chemical Corporation**—The theory and practice of obtaining a good concrete is discussed in the 8-page booklet "Plastiment Concrete Densifier." Beginning with the gel mechanics of cement-water reaction, the booklet tells about the factors affecting cement hydration and basic quality of concrete, also how these factors can be controlled to reduce cracking and increase concrete hardness and impermeability. Illustrated with drawings, tables, and photographs of engineering projects.

### 30 CONCRETE DRILL FOR PLUMBING & ELECTRICAL CONTRACTORS

**Pennsylvania Drilling Company**—Offers new catalogue sheets describing a light weight portable drill designed for drilling holes in concrete floors, walls and ceilings for use by plumbing and electrical contractors for running pipe and conduit. Bits for use with this drill will penetrate any material including reinforced concrete.

### 31 CONCRETE DRILL FOR TESTING LABORATORIES

**Pennsylvania Drilling Company**—Offers new catalogue sheets describing a light weight portable core drill for use by testing laboratories for taking cores from concrete and reinforced concrete for testing purposes. Bits are available for taking cores up to 6" in diameter.

### 32 CONCRETE EQUIPMENT HANDBOOK

**Gar-Bro Manufacturing Company**—A 56-page Manual for "Handling and Placing Concrete" is offered. It is a condensed handbook which covers all phases of concrete construction methods from the selection of concrete through the batching and placing procedures. It provides complete check lists of job specifications, job conditions and equipment; lists current technical data; includes many tables; illustrates correct and incorrect placing methods and shows unusual jobs and how they were solved.

### 33 CONCRETE PAVEMENT DESIGN

**Portland Cement Association**—An 86-page edition simplifies and expedites design procedure for roads and streets carrying all classes of traffic. This manual for the practicing engineer includes design charts for tiebars and dowels, an expanded section on subbases, two pages of joint details and a simplified procedure for determination of "controlling wheel load."

### 34 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

**American Concrete Pipe Association**—An official publication is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

*N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.*

### 35 CONCRETE PIPE HANDBOOK

**American Concrete Pipe Association**—A handbook contains 384 pages on the manufacture and use of concrete and reinforced concrete sewer and culvert pipe. Discussion of Marston's Theory and maximum and minimum allowable depths of fill is presented along with examples and tables. Useful hydraulic data and information on jacking pipe lines is given. A thorough, comprehensive discussion of the use of concrete pipe in sewers and culverts is included. Appendix contains A.S.-T.M. and AASHO specifications. Price $4.00.

*N. B. There is a charge for this book. Make checks payable to The American Concrete Pipe Association.*

## CATALOG DIGESTS

**36 CONCRETE PRESSURE PIPE**

**Price Brothers Company**—"How to Lay Concrete Pressure Pipe" is the title of a new 16-page handy pocket-size instruction book published. Gives step-by-step procedure, in photographs, drawing and text.

**37 CONCRETE REINFORCING DESIGN HANDBOOK**

**Concrete Reinforcing Steel Institute**—Has a unique, 412-page manual, offering finished design data for every principal type of reinforced concrete building member—already worked out in tabular form. No formulas or calculating needed—just apply load and span requirements to the appropriate table and read off complete data. Indispensable for engineers, designers and architects. Follows current codes and practices. Price is $5.00 per copy.

*N. B. There is a charge for this book. Make checks payable to the Concrete Reinforcing Steel Institute.*

**38 CONCRETE-REINFORCING WITH FIBRE TUBES**

**Sonoco Products Company**—A comprehensive 8-page folder describing economies and advantages of using fibre tubes (Sonovoids) for the construction of reinforced concrete floors, roofs, walls and bridge deck slabs. Well illustrated with pictures, diagrams, charts and tables.

**39 CONCRETE, RETARDING DENSIFIER**

**Sika Chemical Corporation**—An 8-page brochure, illustrates with graphs and pictures, the action of Plastiment, on portland cement. It is shown how this action controls set and reduces water content without changing air content, surface hardness and resistance to water and cracking. Proof of these claims is presented in the form of reports covering outstanding structures built with Plastiment concrete.

**40 CONCRETE SAWS**

**Clipper Manufacturing Company**—Offers a series of factual Case History Studies on the uses and advantages of Clipper Concrete Saws by form number: No. 19—Utility Company: No. 20—Concrete Contractor: No. 21—Building Contractor: No. 22—Municipalities: No. 23—Sewer, Trenching, Pipeline Contractor: No. 24—Electrically Powered Saws: No. 25—Plant Maintenance: No. 26—Paving Contractor (Airfields): No. 29—Paving Contractor. Also available is an illustrated circular on the 5 models, gas and electric powered, of Clipper Concrete Saws.

**41 CONCRETE SAWS**

**Eveready BrikSaw Company**—A new illustrated circular describes the Eveready "Powr-Drive" Concrete Saw and its applications by various types of users—Paving Contractors, Industries, Municipalities, Airports, etc. The advantages of the self-propelled Eveready "Powr-Drive" Saw are given as: increased cutting footage per day; less operator effort, and increased blade life. The circular is profusely illustrated with the "labor-saving" features that are incorporated in the concrete saw.

**42 CONCRETE TANK RESTORATION**

**Western Waterproofing Co.**—A well-illustrated folder describes services for maintenance and restoration of concrete storage tanks. Tells how to recognize concrete storage tanks. Tells how to recognize concrete deterioration, explains what causes it and suggests a time-tested system for assuring lasting protection. Illustrations show examples of concrete elevators before, during and after restoration work.

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**ANOTHER PROBLEM SOLVED BY SPENCER, WHITE & PRENTIS**

As average pile pier has only 3 piles, every pile must be perfect
454 big piles driven open end to bedrock
Drill rig pierces rock cribs, old piers, sunken ship

**Project:** Foundation for Colgate-Palmolive Co. industrial service bldg., Jersey City, N. J.

**General contractor:** George A. Fuller Corp.

**Architects & Engineers:** Albert Kahn Associated

ENGINEERS OVERCOME OBSTRUCTIONS IN COMPLEX PILE-DRIVING JOB

For a large structure—450 x 220 ft.—having column loads running as high as 900 tons—a firm foundation was of great importance. This entailed great difficulties.

Between ground and bedrock lay a labyrinth of obstructions: boulders, rock cribs, old Cunard Line piers, even a sunken steel ship. Through all these, it was necessary to drive 22-inch diameter steel piles open end to rock. Each pile was designed to carry 230 tons; some were tested to 345 tons.

Old hands with difficult pile-driving problems, Spencer, White & Prentis took this one in stride, using alternate driving and drilling procedures to pass through the obstructions and seat the 454 piles securely on bedrock. Piles were then cleaned by compressed air and filled with high-strength concrete.

CATALOGUE ON REQUEST

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# CATALOG DIGESTS

### 43 CONTROLLED AIR PRESSURE SYSTEM

**Infilco Inc.**—Bulletin 1100 describes the principle, design and applications of the C.-A.-P. System which provides an instant accurate measurement of head loss and flow and an instantaneous automatic adjustment of flow rate for filter plant operation.

### 44 CONTROLS FOR LIQUIDS AND GASES

**Simplex Valve & Meter Company**—Bulletin 004, 34 pages, lists many types of controllers, gauges, recorders, meters, manometers, valves, Venturi tubes for the measurement of liquids and gases for water and sewage works, power and process industries. Descriptions of units, their operating characteristics, construction details, specifications and other data are described in this general catalog.

### 45 CONVEYING AND MIXING EQUIPMENT

**Link-Belt Company**—Conveying and mixing equipment for chemical flocculation at water, sewage and industrial waste treatment plants is described in Book No. 2442. Two types of mixers are shown for rapid and slow mixing operations, together with conveying and elevating equipment for economical handling of bulk or packaged chemicals. Tested layouts and selection tables to aid in determining suitable tank size for required circulation flow are included.

### 46 COPYING PROCESS

**Charles Bruning Company**—Has made available an 8-page booklet explaining the principles used in the Bruning Copyflex copying process. In addition to explaining the process, the booklet also describes its use in the engineering field and illustrates the complete line of Copyflex machines.

### 47 CRANE-EXCAVATOR

**Wayne Crane Division, American Steel Dredge Company Inc.**—New 8-page catalogs in color illustrate the heavy-duty wheel-mounted Model 20, truck-mounted Model 40 and crawler-mounted Model 66 Crane-Excavators. These individual catalogs are entitled: "Meet the Heavyweights" and feature many shots of Wayne Crane Crawlers in action. Also, illustrated are many of the features which have proved to be outstanding money-savers for Wayne Crane owners. These include simplified deck machinery layout, oversize drums and clutches, and extra-heavy rugged crawler construction. Complete specifications, operating data and lifting capacities are included.

### 48 CRANE RAILS AND FASTENINGS

**United States Steel Corporation**—A 12-page booklet, ADV-19803, containing illustrations and descriptions of three special crane rail sections and their accessories, such as joint bars, bolts, nuts, spring washers and rail clamps designed especially for heavy duty service. Physical properties of the rail sections are listed in addition to drawings and specifications of the rails and their accessories. Recommendations for correct installation, together with a sample 250′ crane rail layout are fully explained.

### 49 CRAWLER TRACTOR

**Allis-Chalmers Manufacturing Company**—The HD-15 27,850 lb Diesel powered crawler tractor that develops 109 drawbar hp. is described in this 16-page color catalog. Unit construction, easy-shift transmission, 1000-hour lubrication for truck wheels, A-type truck frame, hydraulic steering and operator comfort are outlined.

### 50 DESIGN EXTRACTS—SHEET PILING

**United States Steel Corporation**—A 50-page book ADV-18605, containing comprehensive design data concerning steel sheet piling. The material in this book was taken from the publication "Carnegie Steel Sheet Piling," which, when first published during the early 1930's, was one of the first handbooks available on the subject.

### 51 DIESEL POWERED EQUIPMENT

**Caterpillar Tractor Co.**—Pipe line contractors will be interested in a recent publication, entitled, "Here's Why You find Cat-Built Machines on so Many Spreads," Form D404. The booklet discusses the importance of control, teamwork, dependability and safety in the machines working on a spread. Included in the easy to read folder type booklet are 20 vivid photographs of Caterpillar diesel powered equipment in pipe laying operations "all along the line," which include ditching, bending, lining up, welding, cleaning and priming, coating and wrapping, lowering in, and backfilling.

### 52 DOCK, WHARVES AND PIERS

**DeLong Corporation**—12-page illustrated booklet describes new technique of dock construction which eliminates 90% of field labor in the erection of piers, wharves, drilling platforms—either temporary or permanent. The Delong steel dock can be prefabricated anywhere in the world, in shipyards where costs are controlled. The DeLong dock-barge, carrying its own installation gear, is towed to site. Barge is transformed into a dock in only a few days, ready to berth ocean-going ships. Booklet illustrates DeLong installations of 50 ft by 1000 ft dock for Army north of Arctic Circle and 82 ft by 1130 ore and cargo handling dock on Orinoco River, Venezuela.

### 53 DOORS

**The Kinnear Manufacturing Co.**—The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features, and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 80, it gives information on installation clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

### 54 DOUBLE-X MECHANICAL JOINT PIPE

**The American Cast Iron Pipe Company**—Manufactures Mono-Cast centrifugal pipe in diameters 2 in. to 48 in. inclusive. Among the joints offered with this pipe is the American Double-X Mechanical Joint. A booklet describing this product gives dimensions, weights and metal thicknesses. The booklet contains 44 pages and is illustrated.

### 55 DRAG SCRAPERS FOR TRACTORS & BOOM MACHINES

**Sauerman Bros., Inc.**—Field Report 209 shows how a scraper powered by a two-drum hoist mounted on a tractor can work in places which allow none of the head room or surfaces other machines require. Describes clean-outs under culverts, bridges and along rivers. Field Report 219 shows how to make a boom machine reach farther and dig more. In general, a Crescent scraper 50% larger than the regular bucket may be used.

### 56 EARTH DIGGER

**Acker Drill Company, Inc.**—Offers an 8-page bulletin describing the Acker Earth Digger which is ideal for soil sampling or speedy digging of holes for setting telephone poles, guard rails and fencing. Unit can be jeep or small truck mounted.

### 57 ECHO DEPTH RECORDER

**Bludworth Marine, Div. of National-Simplex-Bludworth, Inc.**—A specification sheet describing survey model ES-1025 Supersonic Echo Depth Recorder is offered. This instrument provides a permanently recorded graph of underwater contour as well as an indication of the constituency of bottom materials. Underwater survey groups, dredging companies, bridge builders and underwater pipeline companies will find this equipment most interesting.

### 58 EFFECTS OF CALCIUM CHLORIDE

**Solvay Process Div., Allied Chemical & Dye Corp.**—Has prepared a 40-page, semi-technical booklet of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air-entraining, high early strength and low heat cements.

### 59 ENGINEERING INSTRUMENTS

**W. & L. E. Gurley**—An illustrated 64-page catalog, No. 50, describes the complete line of Gurley engineering instruments. Description and specifications of several types of transits, levels, alidades, leveling and stadia rods, and plane tables with accessories are listed. Dip needle, cruising and geologists compasses are included, as well as current meters, water level recorders and wind instruments.

### 60 ENGINEERING TEXTBOOKS AND REFERENCES

**The Ronald Press Company**—Described in a special brochure is a selected list of current technical books of special interest to the engineer. These authoritative and up-to-date references and textbooks cover many important aspects of structural analysis, design, model testing, and management.

### 61 FILTER EQUIPMENT

**Infilco Inc.**—Bulletin 1560-B includes technical data and description of the Stellar Filter for filtering through diatomite or other filter-aid without the use of coagulants. The Stellar Filter is designed to treat 300 gph to several thousand gph.

### 62 FINISHING MACHINES

**Flexible Road Joint Machine Company**—A new bulletin, P-111, covering concrete finishing machine equipment, has just been released. This bulletin details the various and varied functions of mechanical equipment for concrete slab finishing. Many jobs heretofore believed impractical for mechanical equipment are described. Custom-built machines to meet specific paving problems and the use of the same machine for standard road, street, highway and airport construction are also described.

### 63 FIRE HYDRANTS

**M & H Valve and Fittings Company**—Offers Circular No. 11, "How to Extend or Repair". Fully illustrated in detail on: how to extend hydrant; how to disassemble hydrant; breakable joint features and repair accessories. Also includes parts list for M & H Hydrants.

### 64 FIRE PUMPS

**Economy Pumps, Inc., Div. of C. H. Wheeler Mfg. Co.**—A 4-page folder containing illustrations, capacities on fire, booster and tank pumps. Also, include dimension charts and typical specifications as a guide to fire pump selection.

### 65 FLOATING AND FINISHING MACHINES

**Whiteman Manufacturing Company**—Offers leaflets illustrating their Model B, J-1 and C-4 Floating and Finishing machines. Detailed information and photographs are shown. Also included is a leaflet on the Whiteman Disc Float, especially designed for use on patented-method floors.

There are 186 Digest items on pages numbered 108 to 126. Read all items for the literature of interest to you.

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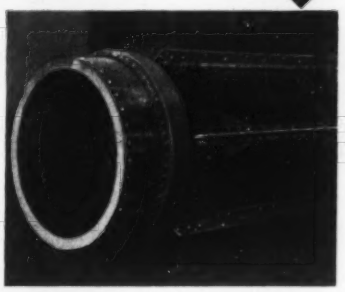

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## CATALOG DIGESTS

### 66 FLUORIDATION

**Proportioneers, Inc.**—Bulletin SAN-9 gives the complete story on the feeding of fluorides for the reduction of dental caries. It explains the methods of feeding sodium silico-fluoride and hydrofluoric acid under pressure. Special attention is given to the accurate control of feeding in strict proportion to the flow. Equipment is described for feeding into pressure line.

### 67 FORMING SYSTEM

**Symons Clamp & Mfg. Co.**—Offers a 40-page catalog, F-9, on its system of wall-form construction. Latest information and improvements in the Symons Forming System are given. Illustrations show in detail: how simply and easily the forming system operates; actual construction where forms have been used; the forms are shown in use as well as in completed jobs; blueprint illustrations and complete specifications are given; material and equipment necessary and time required and cost figures on actual jobs. Also contains detailed information on Safety Shores and Column Clamps.

### 68 FOUNDATIONS

**Drilled-In Caisson Corporation**—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.

### 69 FOUNDATIONS AND HEAVY CONSTRUCTION

**Spencer, White & Prentis, Inc.**—Has literature on the construction of difficult and unusual foundations, description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations; Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

### 70 FLY ASH

**Chicago Fly Ash Company**—AIA File 3-B-2 offers information on the rapidly growing practice of incorporating Fly Ash in concrete in the proportion of 15% to 35% by weight of the total cementing material. Fly Ash is a man-made "Pozzolanic" agent which improves the resulting concrete, yet lowers its cost. An ancient, successful method, brought up to date. Description of process, technical data, result of tests are enclosed.

### 71 GATES CONTROL WATER LEVELS

**Thompson Pipe & Steel Company**—A bulletin shows how two new, simple automatic gates control and maintain accurate water levels either above or below gates for streams and canals, water and sewage plants and other open-channel uses—at considerable less cost than conventional automatic gates. New design principle. A third device maintains uniform discharge with varying head on upstream side. The bulletin illustrates many typical uses to save water, lower maintenance costs and eliminate flood damage. Design and installation diagrams are included.

### 72 GEARS AND OPERATING MACHINERY

**The Earle Gear & Machine Co.**—Bulletin describes products, facilities and designing services: gears of all types in all practical materials; other products closely related to the manufacture of gears, such as racks, sprockets, sheaves and special machinery of which gears form a part. Also includes a table of gear formulas with related blue print references; ordering information and a few installation photos to illustrate the wide applications of products.


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Shown, model 7014 with "A" standard. Model 7020, same unit with "U" standard, also available.

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For example: White uses a recently-developed Swiss Dividing Engine to cut graduations into solid silver. This insures super-precision from the beginning, safeguards it through more years of hard field usage.

In addition, White engineers' transits give you internal focusing, covered leveling screws and coated optics. These and a host of other design and operating features combine to give you a transit unsurpassed for ease, speed, accuracy, economy and long-lived dependability. Write for Bulletin 1053 and the name of your nearest dealer. DAVID WHITE COMPANY, 359 W. Court Street, Milwaukee 12, Wisconsin.

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**We offer expert REPAIR SERVICE on all makes, all types of instruments**

### 73 GRATING FLOORING AND TREADS

**Irving Subway Grating Co., Inc.**—Just published its new Catalog F400, containing illustrations, descriptions and complete engineering data on grating flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial and power plant and refinery walkways, stairways, driveways, trucking aisles, etc.

### 74 GRAVITY FILTERS

**The Permutit Company**—Bulletin 2539A, 24 pages, should be of interest to all operating, consulting and architectural engineers dealing with water problems. It shows the complete line of rapid-type gravity filters, which are made in three basic types of concrete, of steel and of wood. Specifications, operating characteristics, outline dimensions and typical installations of these filters and associated accessories have been included.

### 75 GROUTING

**Intrusion-Prepakt, Inc.**—Prepakt Concrete and Intrusion grouting provide many advantages in new and maintenance construction. Methods, materials and applications are described in a fully illustrated 24-page bulletin.

It's a big jump
to SEATTLE
and the
A.W.W.A. Convention
May 23 to 28
We'll hit the silk and get there in time to extend you a warm welcome. Be sure to visit R. D. Wood Company's booth. There will be a display of R. D. Wood products, including America's best-known hydrant, the Mathews.

**MATHEWS HYDRANTS**

**Made by R. D. Wood Company**

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves


### 76 GUNITE

**Pressure Concrete Company**—Has a 48-page illustrated, free booklet on Gunite in all of its phases. The booklet contains specifications, job stories, and illustrations showing Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on new prestressed tank construction and much other data. A new leaflet just published illustrates pressure grouting to dams.

### 77 HEAVY DUTY MOTOR OILS

**Standard Oil Company (Indiana)**—A 12-page illustrated booklet covering the history and development of Standard's heavy-duty motor oils is available. This bulletin reviews the performance requirements of heavy duty motor oils and defines the new A.P.I. service classifications.

### 78 HEAVY DUTY TRAILERS

**Birmingham Manufacturing Co., Inc.**—Catalog C-7A illustrating by photographs and detailed information their line of heavy duty trailers is now available. These trailers are skillfully designed to give you bigger "job pay-off", ease of handling and rugged wear.

### 79 HEAVY TIMBER ROOF DECKING

**Timber Structures, Inc.**—New folder "Tim-Deck" shows how to do the work of sheathing, purlins, joists, insulation and ceiling all with one application of 3½ in. thick tongue-and-groove sheathing. Includes discussion of fire resistance and comparative insulation value together with data on beam spans, installation and calculations of area takeoffs and board footage. Photographs illustrate typical applications in churches, schools, gymnasiums, commercial buildings and interior partitions.

### 80 HIGH STRENGTH CORROSION RESISTING STEEL

**Bethlehem Steel Company**—The use of high-strength, low-alloy steel is rapidly increasing in practically every branch of industry. In a 66-page catalog, "Mayari R—Bethlehem's High Strength Corrosion Resisting Steel," the properties and outstanding features of this steel are described. Included also are many photographs illustrating its use in equipment for the construction industry: in bridges, pipe and penstocks; and in mining, transportation, and other industrial fields.

### 81 HIGHWAY BRIDGE BOOKS

**American Association of State Highway Officials**—Offers a two-volume edition, "Public Roads of the Past," Volume I, and "Historic American Highways," Volume II, of the history of roads, methods, instruments and influences. Both volumes have complete bibliographies, illustrated with both maps and sketches. Volume I, the European phase, from earliest recorded history (about 3500 B.C.) thru rise and fall of Roman Empire, discovery of New World, to 1800. Volume II, is the record of transportation development in America. Price is $3.00 for Volume I and $4.00 for Volume II, or $6.00 per set.

N. B. *There is a charge for these books. Make checks payable to American Association of State Highway Officials.*

### 82 HOISTING MACHINERY

**Superior-Lidgerwood-Mundy Corporation**—Bulletin H-414 describes and illustrates a full range of steam, electric, gasoline and diesel-powered hoisting machinery built in standard sizes. Complete information given relative to drum sizes, line pulls, horsepower ratings, weights, etc. This bulletin also includes boom swinging gears and special data—how to figure rope capacities of drums, how to figure carpuller and capstan loads, which can be handled by hoists using various parts of load lines, and various lead lines.

Turn to page 108 and order your literature.

# CATALOG DIGESTS

### 83 HYDRANTS AND GATE VALVES

**R. D. Wood Co.**—A 22-page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features, with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the removable barrel containing all the working parts, to the completely revolving head, and to the Sand-Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

### 84 HYDRAULIC CRANE

**Austin-Western Co.**—An 8-page catalog, AD-2206RI, pictures and describes the new Austin-Western Hydraulic Crane. This tractor-mounted crane, with its pickup, carrying, and placement capabilities, combines the best features of crawler, truck, and erection cranes with those of industrial shop cranes. All movements are actuated by fast, smooth, hydraulic control.

### 85 HYDRAULIC DATA BOOK

**Leupold & Stevens Instruments, Inc.**—Interpretive data on water measurement and control is at your fingertips in the 144-page revised edition, in three parts: Float Wells and Instrument Shelters; Errors in Float Operated Devices; Hydraulic Tables; plus pages for notes and memorandums. Indispensable for the engineer with its wealth of information, tables, charts and illustrations. The price is $1.00.

*N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instruments, Inc.*

### 86 INCINERATOR STOKERS

**Flynn and Emrich Company**—Bulletin No. 1701 fully describes a proven design of automatic stokers for municipal and industrial incinerators. The bulletin clearly shows the design and operation of this simple, rugged and dependable incinerator stoker that has proven itself in the field.

### 87 INDICATING, RECORDING AND TOTALIZING METER

**Simplex Valve & Meter Company**—Bulletin 402, 18 pages, describes this mercury flow type indicating, recording and totalizing meter that operates in conjunction with Venturi tubes, flow nozzles and orifice plates. The meter is designed for the accurate measurement of water, gas, air, sludge or other industrial liquors and is so calibrated as to give a plus or minus 2% accuracy at any point, over flow ranges as wide as 13:1. The bulletin should be of interest to consulting plant engineers, purchasing engineers and operating personnel.

### 88 INDUSTRIAL SILOS AND STORAGE SYSTEMS

**Marietta Concrete Corp.**—Offers a catalog on modern industrial storage systems, designed to meet specific needs of diversified industries. More than just a silo or tank, these systems are complete storage and materials-handling installations engineered to improve handling facilities, help build reserves, and lower operating costs. There are sections on foundations, roofs, walls, floors and shelves. Photographs, illustrations, details of storage system construction, a capacity chart, etc., are included.

### 89 INTRUSION GROUTING

**Intrusion-Prepakt, Inc.**—New technique, "Mixed-in Place Intrusion Grouting," offers construction engineers a new tool for solving tough soil and foundation stabilization problems. Technique and its applications are described in illustrated 20-page bulletin "Developments and Applications of Mixed-in Place Intrusion Grout Piles."

### 90 JOINT FILLERS AND SEALS

**Servicised Products Corporation**—A catalog gives complete details and specifications on premolded joint fillers, hot-poured Para-Plastic sealing compound, premolded Para-Plastic, molded rubber waterstops, corrugated closure strips, sewer joint seals, asphalt planking, and safety stair treads, curing compounds and air-entraining agents.

### 91 JOINT FILLERS & COMPOUNDS

**Servicised Products Corporation**—Servicised Products for pre-cast and tilt-up concrete construction describes Servicised Cementone rubber joint filler and Servicised curing and separation compounds for tilt-up and pre-cast concrete construction.

### 92 JOINT SEALER

**Sika Chemical Corporation**—A 4-page brochure, illustrates advantages and uses of Igas Joint Sealer, the nonmeltable mastic water stop which is installed after concreting. Information is given on how to seal joints between concrete, steel, ceramic and other construction materials. Sketches and instructions show how Igas joints are installed on or opposite the side of the structure (buildings, tanks, tunnels, etc.) exposed to water pressures.

### 93 JOISTS-T-CHORD LONGSPAN

**Haven-Busch Company**—A well illustrated 35-page booklet explaining types, uses and advantages. Contains charts and specifications, load tables, accessories and applications, also check list for requesting estimators.

### 94 LETTERING MACHINE

**Ralph C. Coxhead Corporation**—The Vari-Typer engineering lettering machine relieves draftsman from tedious hand lettering. The machine operates like a typewriter, but has instantly changeable type faces in different styles and sizes to meet the various needs of the tracing or bill of material. The carriage is designed to hold tracings as much as 6 ft or more in width. The type impressions are electrically controlled producing a uniform, sharp, black character so important to a good tracing. Mathematical symbols as well as draftsmen style lettering are available in the changeable type for cartridge.

### 95 LIGHT WEIGHT PIPE

**Naylor Pipe Company**—A new Bulletin No. 507 has just been issued as a practical help to pipe users. It shows typical applications of its light weight lockseam-spiralweld pipe and fittings. Included are standard specifications on pipe from 4 to 30 in. in diameter, together with data on fabricated fittings, flanges, and connections to meet all pipe line requirements.

### 96 MASONRY CEMENT

**Lone Star Cement Corporation**—A 16-page, illustrated booklet outlines the advantages of Lone Star masonry cement in simplifying the problem of obtaining uniformly high-quality mortar, as well as the economy of one rigidly standardized, ready-to-use cementing material instead of two with no lime or portland cement to add, and no soaking or slaking. It provides timely information on soundness, low absorption, high water repellency and other factors contributing to durable, weather-resistant performance. Contains easily-read graphs showing effect of mix proportions on water retention, strength and absorption, effect of mixing time on water retention, etc., along with convenient reference tables for estimating quantities.

### 97 MEASURING AND CONTROL EQUIPMENT

**Simplex Valve & Meter Company**—Bulletin 050, 4 pages, illustrates various types of measuring and control equipment. General information is given on both primary and secondary measuring devices. Included are short descriptions of Standard and Elliptical Venturi tubes, as well as parabolic flumes used as primary devices to actuate the secondary indicating, recording and totalizing units. Of interest are illustrations and descriptions covering various types of air release and air inlet (and vacuum breaking) valves and the new Controlled Closing Valve.


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Irving Aluminum Grating is the solution where STRENGTH and VERY LIGHT WEIGHT are wanted.

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# CATALOG DIGESTS

### 98 MEASURING FLUMES

**Thompson Pipe & Steel Company**—Self-cleaning Parshall measuring flumes give permanently accurate water measurement for open channels as described in bulletin. Used in water, sewage and industrial plants as well as for irrigation. Presents advantages and also complete table for free flow discharge of throat widths from three inches to twenty feet. Bulletin shows how these flumes stop water disputes and meet with approval of State Engineers.

### 99 MECHANICAL PIPE JOINTS

**R. D. Wood Co.**—A 4-page leaflet describes mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high-pressure lines for oil, gas, water, steam, or chemicals.

### 100 METALLIC AGGREGATE

**A. C. Horn Company, Inc.**—Has prepared an 8-page booklet covering the uses of Vibro-Foil, a metallic aggregate: for non-shrink resurfacing of concrete floors, non-shrink concrete floor patching, non-shrink grouting under machinery, etc. Many important suggestions on the preparation of foundations and specifications are given.

### 101 METRIC WALL CHART

**Mayo Tunnel & Mine Equipment**—Offers an enlarged metric wall chart for the rapid conversion of meters to feet and inches. Also included is a table for the direct conversion of Inches and Fractions to Meters. Available to engineers who work with the metric system.

### 102 MORTAR CEMENT

**Universal Atlas Cement Company**—"Good Masonry Deserves Atlas Mortar Cement" a booklet now available. Masonry is no better than its mortar is the opening point made in this booklet. It also outlines the advantages of using prepared mortar cement, and backs this up with comments from men who use it. It further points out that behind Atlas Mortar Cement are years of laboratory and field research. This quality product complies fully with ASTM and Federal Specifications for masonry cement, and provides in a single material a mortar cement that rates high in all desirable characteristics—plasticity, yield, volume change, water-retention, durability, strength and color.

### 103 MOTOR GRADER

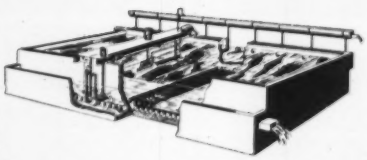
**Allis-Chalmers Manufacturing Company**—The AD-40 motor grader, largest in the Allis-Chalmers grader line, is described in this 16-page color catalog. In addition to describing such features as "Hydraguide" steering, extra high clearance, easy working controls, and full visibility for the operator, the catalog also includes action pictures showing what the various features mean in terms of work the AD-40 can do. Power is provided by a Diesel engine with a rated 104 brake hp.

### 104 MOTOR GRADER

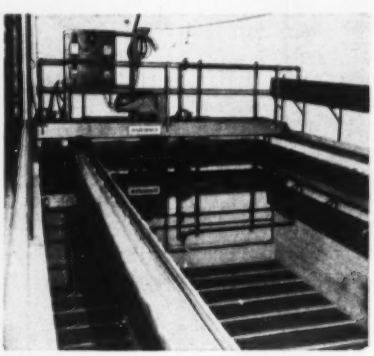
**Allis-Chalmers Manufacturing Company**—Mechanical features, specifications and the many year-round jobs on construction and maintenance of roads and streets, and general construction work, feature the Model D motor grader three-color catalog. Actual photographs tell the on-the-job application story, and illustrations and cutaway view of the complete unit, its "Power-Crater" engine, plus those of important mechanical and construction features of the Model D provide much important technical information. There is also illustrated information about many allied attachments designed for the Model D.

### 105 MOTOR SWEEPER

**Austin-Western Co.**—A 16-page catalog, AD-2170, pictures and describes the Model 40 motor sweeper with its unique direct broom-to-hopper sweeping which makes unnecessary the conventional belt conveyor or squeegee elevator. While designed primarily for use by municipal street and park departments, the Model 40 is also well adapted to use on airports, and in and about industrial plants of many types. Included in the catalog are brief specifications and photographs of the sweeper in operation on typical jobs.

*Investigate the AUTOMATIC BACKWASH RAPID SAND FILTER*



Here is a sand filter which cleans itself —automatically— with no interruption whatever to the filtering operation. No shutdown or changeover is necessary while cleaning is in progress.

The secret lies in its special, compartmented filter bed and traveling backwash mechanism which automatically cleans one compartment at a time.

May be used for plant supply water or for waste water treating. Write for Bulletin 46-A-37.

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## CATALOG DIGESTS

### 106 MOVABLE-BRIDGE ELECTRIFICATION

**General Electric Company**—Announces a new publication on movable-bridge electrification. The 12-page booklet, designated GED-1982, explains why the nation's automobile and railroad traffic growth necessitates new movable bridges. Amply illustrated, it contains case histories of various bridge applications. Information on amplidyne-control, electrically operated center-span drives, and interlocked control also is provided.

### 107 OFFICE COPIER

**Eastman Kodak Company**—Is offering a new leaflet describing their Kodak Verifax Printer. This printer is a typewriter-size office copy machine which can be used to produce three or more copies of any letter or letter-size document in less than a minute, for only three cents per copy when three copies are made. The process and equipment are fully described.

### 108 OIL CLUTCH

**Caterpillar Tractor Co.**—Has recently published a booklet, Form 30961, entitled, "A New Oil Clutch For Your D8". The booklet depicts the advantages of the oil-type flywheel clutch in giving improved performance and reduced operating costs. Photographs show what is involved in a field changeover to the new clutch. Descriptions on how the oil clutch works and how to make a field installation, complete the booklet on this major advance in tractor design. A detailed cutaway drawing of the oil clutch appears on the cover.

### 109 OPTICAL SQUARES

**Henry Wild Surveying Instruments Supply Co. of America, Inc.**—Optical Squares, the size of a plumb-bob, constantly intrigue persons who have not had practical experience with them. By means of Pentagonal Prisms these squares turn a true right angle. They are the smallest and most inexpensive "Transit" for laying out and checking buildings, concrete forms, and boundaries as well as cross sections and Topo maps. A well illustrated booklet on Optical Squares has just come off the press. It explains the working principle and the many fields of application of both the Single and Double Prisms.

### 110 PACKAGE WATER CONDITIONER

**The Permutit Company**—Bulletin 3869, 8 pages, describes Permutit's Package Water Conditioning Plant, an extremely versatile, self-contained unit, designed to coagulate, clarify, filter, neutralize, de-alkalize, and soften raw water supplies. Listed are the component parts, principles of operation, ratings, capacities, and sizes. This bulletin should be of interest to all engineers dealing with water problems.

### 111 PAVING BREAKERS

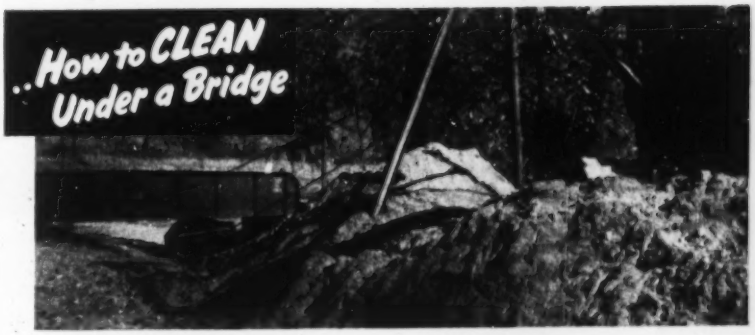
**Joy Manufacturing Company**—Announces a new fact-packed Bulletin 87-P, on their line of Silver Streak paving breakers. Economy and operating features are covered in eight pages of detailed description, specifications, and photographs. Exclusive Joy developments, such as Cadmium Plating and the patented Dual Valve are described. Joy paving breakers are built in four sizes. The bulletin also describes air compressors, rock drills, and other related tools.

### 112 PAVING TREATMENTS

**American Bitumuls & Asphalt Company**—A 28-page, two-color booklet describes in fully scenic photographic form and with basic tabular data the newest practice in step-by-step construction of surface treatments, armorcoats and penetration pavements with Bitumuls emulsified asphalt.

### 113 PENCIL SAMPLE KIT

**American Pencil Company**—FREE! New Venus Blueprint Pencil Sample Kit. See for yourself how new Venus Blueprint Pencils give you more brilliant, clear, non-smear markings on all blue or white prints and coarse papers. Specially formulated lead is the reason. Sharpens to a needle point, never powders or smudges; markings are opaque and insoluble, resist oil and grease. Electronically controlled color accuracy. Kit includes two new Venus Blueprint Pencils plus a Venus Drawing Pencil.


You can clean under bridges and culverts . . . remove sediment from storm sewers . . . work in places which do not allow the head room other machines require . . . efficiently, economically . . . with a Sauerman Crescent Scraper powered by a skid mounted Sauerman Hoist or your tractor or boom machine hoist.

The Crescent, working between an anchorage and the hoist, will deposit excavated material anywhere along the span simply by reversing the forward pull. Through an opening no larger than its own width, the Crescent can be started through an underpass. It digs equally well on firm ground, boggy material or under water.

For full details, illustrations and representative cost figures on the use of a Crescent Scraper with your tractor, write for Field Report 209. For information on the use of Crescent Scrapers with draglines, request Field Report 219 and Catalog J.

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# everything you need for easy soil sampling

**1. portable**
Carry it in your car.

**2. easy to use**
No experience needed to operate.

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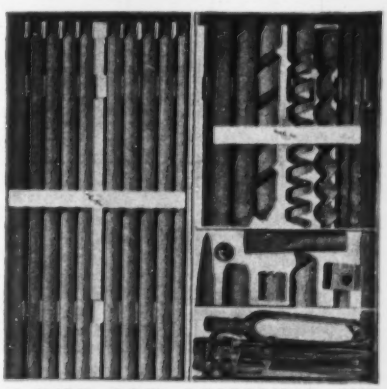
Recovers accurate, undisturbed samples.



## the ACKER SOIL SAMPLING KIT

More than 30 years of soil sampling experience all over the world has proven that this kit is the most versatile, portable collection of soil sampling tools you can buy!

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**ACKER DRILL CO., Inc.** 725 W. Lackawanna Avenue, Scranton, Penna.

*a complete line of Diamond and Shot Core Drills, Drilling Accessories and Equipment*

By proper use of welded design, steel and manhours can be reduced 15% in erection of buildings and bridges

# SEVEN WAYS TO CUT CONSTRUCTION COSTS*

The following savings are a direct result of using welded steel in structural design as compared with traditional riveting or bolting:

**1.** Weight reduction of as much as 15% is realized since the full areas of tension members and tension flanges are effective. Members subject to bending may be designed to take full advantage of continuity. Gusset plates, splice plates and connections are materially reduced . . . often completely eliminated. Height of building is usually reduced since floor beams are of less depth.

**2.** Fabricating time and cost is less because layout, punching and drilling of holes is eliminated.

**3.** Size and cost of foundations is lower where safe bearing power of soil is low.

**4.** Greater freedom in design is possible. Structures can be made fully continuous to provide against forces of hurricanes, earthquakes and atomic blasts. Additions and alterations to existing structures are easier.

**5.** Design time is less because welded designs take fewer details, involve fewer pieces.

**6.** Maintenance costs are lower. Smooth surfaces on welded connections mean less corrosion, less painting.

**7.** Noise of erection is eliminated . . . an important factor in areas near hospitals and office buildings.

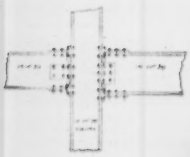

**Fig. 1. Typical Riveted Connection** *of floor beam to column. Auxiliary steel required: 53 rivets (⅞"); 4 pieces 18" I beam; 2 pieces 6" x 4" angles; 2 pieces 4" x 3½" angles.*

**Fig. 2. Typical Welded Construction** *of floor beam to column. Auxiliary steel . . . only 3.2 pounds welding rod; 4 erection clips.*

*Condensed from paper by Fred L. Plummer, Director of Engineering, Hammond Iron Works, Warren, Pa., published in Proceedings of the Second Illinois Structural Engineering Conference.

**HOW TO DESIGN FOR LOW COST**

Lincoln Studies in Structural Arc Welding present latest construction ideas for efficient low cost design. Available by writing on your letterhead to The Lincoln Electric Company, Cleveland 17, Ohio.

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**THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT**

## CATALOG DIGESTS

### 114 PENCILS

**Eberhard Faber Pencil Company**—Announces the publication of their new general catalog, featuring their line of wood cased pencils, erasers, crayons, Mupastels, rubber bands and type cleaners. Any dealer who has not received a copy, may obtain one by writing directly to the company.

### 115 PILES

**Raymond Concrete Pile Company**—Standard and step-tapered piles are described in Catalog S-54 which also includes information on the scope of Raymond's activities covering every recognized type of pile foundation—concrete, composite, precast, steel, pipe and wood piles; also caissons, underpinning. Domestic operations also include construction involving shore protection, shipbuilding facilities, harbor and river improvements and cement-mortar lining of pipelines in place. Raymond's foreign services include every type of construction.

### 116 PILES

**The Union Metal Mfg. Co.**—Test load data, engineering tables and descriptive information are contained in Catalog No. 81 on Monotube piles. It also includes numerous photos showing a wide range of job applications throughout the country. The Monotube is a fluted, tubular steel pile, either fully tapered or combining tapered and uniform sections. It is driven directly with a standard crane, leads and hammer, without the use of driving core or mandrel. Advantages listed: light weight, easy handling, speedy driving, economical field extensibility, visual inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

### 117 PIPE CEMENT LINING

**Centriline Corp.**—A booklet describes the method of reconditioning pipe lines in place by placing a cement mortar lining on the inside surface which will stop leaks, corrosion and increases flow coefficients. This work can be done in pipe diameters from 4 in. to 144 in. with a minimum interruption of service.

### 118 PIPE CLEANING EQUIPMENT

**Flexible Sewer-Rod Equipment Co.**—A 26-page catalog, "Power Bucket Machine", offers a model for every job where pipe cleaning tools and equipment are needed. Fully illustrated with photographs and detailed information it shows a complete line of Power Bucket Machines and gives practical suggestions as to their use and care.

### 119 POCKET TRANSIT

**Wm. Ainsworth & Sons, Inc.**—A booklet describing and outlining the use of the Brunton pocket transit and accessories is available. The booklet shows how horizontal and vertical angles can be determined to approximately one degree by an instrument weighing only 8½ ozs.

### 120 POWER BUGGY

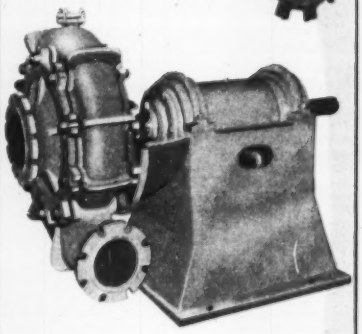
**Whiteman Manufacturing Company**—Fully illustrated in leaflets now offered are the Model UPB, DB52, and FR-51 Models of the Power Buggy. For use in any industry: manufacturers, construction, warehousing, etc., these are man-hour savers, speedy, tough, versatile and economical.

### 121 POWER GRADERS

**Austin-Western Co.**—A 24-page catalog, AD-2112-R1, pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

GIW

SLURRY PUMPS



The performance of these pumps is remarkable. Their stamina and efficiency are documented by two years of laboratory and field tests. This is the happy answer to the problem of pumping highly abrasive slurries at high solid concentrations and over a wide range of heads and capacities. Their capacities range from 50 to 8000 GPM against heads up to 150'.

Write for our illustrated booklet. If you wish, there is a representative near you who will be glad to call if you desire.

GEORGIA IRON WORKS CO.
EST. 1911
Twelfth Street, Augusta, Ga.

# CATALOG DIGESTS

## 122 PRECIPITATOR

**The Permutit Company**—Bulletin 2204B, 20 pages, covers applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of Permutit's Precipitator. Three basic designs offer efficient means of removing impurities from a liquid by precipitation, adsorption, settling, and filtration. It requires less space, less chemicals and less reaction time than previous designs. Softens water, removes turbidity, color, taste, odor, reduces alkalinity, silica, and fluorides.

## 123 PRECISION INSTRUMENTS

**C. L. Berger & Sons, Inc.**—"Solar Ephemeris and Polaris Tables," 1954 Edition, 96 pages. Contains complete instructions for determining azimuths from the sun and the altitude of Polaris, prepared by Herman J. Shea, associate professor of surveying, Massachusetts Institute of Technology. Directions for making astronomical observations and computing results by direct solar observation and time from same observation; meridian by solar attachment; meridian by Polaris at elongation; azimuth by Polaris at any hour angle; latitude by sun at noon, and latitude by Polaris are included, as well as all requisite tables. Price is $.50 per copy.

N. B. *There is a charge for this book. Make checks payable to C. L. Berger & Sons, Inc.*

## 124 PRECISION INSTRUMENTS

**C. L. Berger & Sons, Inc.**—Complete specifications on the Berger "N" line of moderate-priced builders' instruments are included in an illustrated brochure now available. Companion line to the company's engineering, mining and astronomical instruments, the "N" line consists of a convertible transit-level, a 12-in. heavy-duty dumpy level, a service transit level (farm level) and a hand level.

## 125 PRECISION INSTRUMENTS

**C. L. Berger & Sons, Inc.**—An informative, 4-page brochure, combining a catalog and calculating chart, has been prepared. Pictured in four colors on the cover is the Berger Type R transit, one of the many instruments produced by the 82-year-old firm. On the center spread are photographs and code names for 12 types of Berger instruments, from an 18-in. dumpy level to a plane table alidade.

## 126 PRECISION TRANSIT

**Warren-Knight Co.**—The new circular, CE7, describing the latest Model medium size Precision Transit No. 7-cF is available. This new Model Transit has a number of exclusive features that make it the outstanding instrument of its kind today. The Transit has a new 24 power internal focusing telescope with disappearing stadia, axle end focusing, replaceable leveling screws in bushings, etc., and weighs less than 13 lbs without using any light alloys in its construction.

## 127 RADAR

**Bludworth Marine, Div. of National-Simplex-Bludworth, Inc.**—Radar and radio direction finders for offshore position location. Nine models available to suit your needs. Literature and prices on request.

## 128 RAILS

**L. B. Foster Company**—To serve every type of industry that uses trackage, a new catalog, No. 575, titled "Rails", has been issued. Illustrations of rail sections in the catalog are in profile complete with design dimensions all in actual size for use in comparison with actual and section samples, or for use with tracing drawings. Angle and splice bars are illustrated on each section from 12 to 155 lb inclusive, and on crane rail sections from 104 to 175 lb. Handy specification tables are shown with each diagram. Complete ordering instructions and specifications are given.

## 129 REINFORCED BRICK MASONRY

**Structural Clay Products Institute**—The first complete, authoritative handbook on the use of reinforced brick masonry in construction, entitled "Reinforced Brick Masonry and Lateral Force Design," fills a recognized need for technical information on lateral force design in masonry for architects and engineers. The principles of R B M design are the same as those nationally accepted for reinforced concrete but offer lower cost and more flexibility. The book reviews accepted design criteria, suggests methods of calculating stresses, and recommends reinforced brick masonry building code requirements.

## 130 ROCK DRILLS

**Joy Manufacturing Company**—Offers Bulletin 87-X, illustrating five of the modern Joy rock drills: the heavyweight LB-57 in the 55 lb class, the 45 lb L-47, the 35 lb L-27, the lightweight L-27, and the DH-4 plug drill. Exclusive Joy features make these rock drills the top performers: Cadmium Plating, which prevents rust and aids lubrication; and the Dual Valve, the patented Joy design development that "make air do more work."

## 131 ROLLS

**Rodney Hunt Machine Co.**—Has released a revised edition of a complete catalog on metal, rubber, wood and plastic rolls. The catalog consists of 48 pages with an appendix of tear-out dimension sheets for use in supplying specifications on rolls, fulling-mill lags and textile machinery reels. Also includes a page on the simple but valuable routine by which wood or rubber rolls, properly cared for, can be made to deliver a greatly extended service life.

## 132 RUBBER ROADS

**Natural Rubber Bureau**—A 52-page booklet entitled, "Stretching Highway Dollars With Rubber Roads," is offered. This booklet gives the whole story on the history of rubber roads, and describes in detail the test roads using natural rubber powder that have been laid in the United States and Canada through the 1951 paving season.

## 133 SAFETY FLOORING

**The Master Builders Co.**—A 12-page illustrated booklet on DPS Masterplate, for producing a static-disseminating, spark-resistant, non-combustible, heavy-duty, abrasion-resistant iron-clad concrete floor surface. A DPS Masterplate floor surface is a precaution against loss of life, property and production from fire and explosion caused by static and mechanical sparks. Booklet describes the product, tells how it is used and gives performance test data.

## 134 SANDBLAST MACHINE

**Sanstorm Manufacturing Company**—Bulletin AB-11-52 disclosed initial enlightenment on Sanstorm Pressure Type Sandblast Machines involving two sizes, four models, in portable and stationary arrangements. These models are designed for any type of heavy duty sandblasting or blast cleaning operation and guaranteed to offer Sanstorm's famous non-stop, non-plug blasting action for the highest degree of efficiency and economy attainable in pressure type blast cleaning operations.

## 135 SAND BLAST NOZZLE HEAD

**Sanstorm Manufacturing Company**—Bulletin WJ-1 discloses pertinent information to the Sanstorm Wet Jet Nozzle Head. A small convenient, lightweight, low priced attachment for arrangement with any type of pressure type sandblast or blast cleaning operation for the accomplishment of a definite, wet, dustless, pressure type sandblast machine performance. The Wet Jet is designed for employment in the blast cleaning of building facades, houses, and other structures which are located in congested areas and where City ordinances re dust, etc., must be observed.

## 136 SCREW CONVEYORS AND FEEDERS

**Link-Belt Company**—Screw conveyors and screw feeders, simple and versatile handling mediums for hundreds of materials, are covered in Book No. 2289. Over 250 of these materials are listed and classified by size, flowability, abrasiveness, average weight and other characteristics. The book also gives detailed engineering information, with selection tables and horsepower formulas, layouts and arrangements, dimensional data and part numbers, to permit selection of screw conveyors and screw feeders for many applications.

## 137 SEWAGE REGULATORS

**Brown & Brown, Inc.**—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems, either by cutting off such flows entirely during storm periods, or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

## 138 SEWER CLEANING EQUIPMENT

**Flexible Sewer-Rod Equipment Co.**—A 37-page catalog No. 53-A entitled, "Why Preventative Maintenance", describes a complete line of sewer cleaning and maintenance equipment. Fully illustrated with photographs and detailed information, the catalog shows various equipment and the "Flexible" way of using it on the job.

## 139 SHAFT EQUIPMENT

**Mayo Tunnel & Mine Equipment**—Offers Bulletin No. 20, illustrated by photographs, showing various types and uses of shaft equipment. Also includes Kibbles, Gilleys, Air Locks and pneumatic Grouter.

## 140 SHOT CORE DRILLS

**Acker Drill Company, Inc.**—Offers a bulletin describing the Model KR shot core drill. The KR drill is especially suited for obtaining highway and airport runway test cores from concrete, bituminous or masonry surfaces. The entire unit is light enough for mounting on a pick-up truck or trailer. Power unit can be gasoline, kerosene, diesel or electric motor.

## 141 SOIL SAMPLING TOOLS

**Acker Drill Company, Inc.**—Offers a 16-page bulletin describing their complete line of soil sampling tools. The science of soil mechanics and the special tools required for accurate sub-surface exploration in various soil conditions, is thoroughly discussed.

## 142 STEEL DREDGES

**American Steel Dredge Company Inc.**—A 16-page catalog illustrating in color its full line of hydraulic dredges is available. A series of field photographs shows the 15, 12, 10 and 8 in. sizes hydraulic dredges in operation. In addition, many of the modern design and construction details are illustrated. A table of typical dredge data is included for handy reference of dredge specifications.

## 143 STEEL FABRICATION

**The Ingalls Iron Works Company**—Offers a bulletin "36 Ways to Measure Know-How," illustrating the many office buildings, power plants, factories, refineries, hangars and public service buildings that stand as evidence of the specialized craftsmanship of one of the country's largest fabricator of steel.

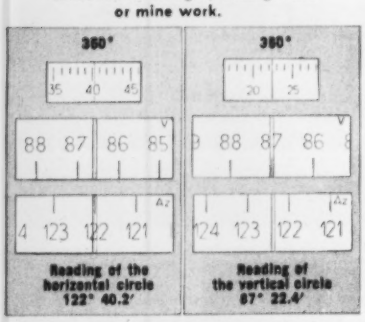
DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

ARE YOU GETTING THE NEW ANGLES...

...THE MODERN WILD® HEERBRUGG WAY?

WILD T-1
OPTICAL *REPEATING* TRANSIT Rugged, compact design ...with 20 years of proven service under tough field conditions.

Both circles read from one single station through microscope alongside telescope eyepiece. Optical micrometer eliminates possibility of reading error. Illumination is provided by daylight mirror or by battery attachment for night, underground or mine work.

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# CATALOG DIGESTS

## 144 STEEL FORMS

**Economy Forms Corp.**—A booklet on steel forms for concrete construction is offered. It has numerous pictures showing the simple handling, applications, and use of the forms for all types of heavy construction; tunnels, culverts, sewage & water treatment plants. Special forms designed to solve concrete construction problems are also shown.

## 145 STEEL MILL DRIVE ENGINEERING

**General Electric Company**—A new bulletin showing examples of steel mill drive engineering at work is now available. The 16-page publication, designated GEA-6034, provides information on various applications of drive engineering including annealing and acid tinning lines, ore bridges, sintering lines, main drives for hot-strip and cold-strip mills, and auxiliary drives for a blooming and slabbing mill.

## 146 STEEL SHEET PILING

**L. B. Foster Company**—Contractors faced with the problem of selecting proper piling for construction projects will find their task simplified because of a new catalog titled "Steel Sheet Piling", No. 575D. Giving comparative information on steel sheet piling manufactured by major steel companies, the 20 page catalog also cites the advantages of renting piling; gives piling data related to circular and diaphragm-type cellular cofferdams, circular cofferams, pile extractors and pile hammers and specifications for piling sections.

## 147 STEEL WATER PIPE

**Armco Drainage & Metal Products, Inc.**—Offers a 98-page manual, "Design Standards for Steel Water Pipe." It covers uses, determining size and wall thickness of supply lines, field joints, expansion joints, special connections, and other related subjects. Charts, tables, formulas and photographs supplement the text. Originally published by the American Waterworks Association, Inc., from a paper presented by Russell E. Barnard, Advisory Engineer, Armco Drainage & Metal Products, Inc.

## 148 STRUCTURAL SHAPES

**United States Steel Corporation**—A 72-page hard-bound book, ADV-17831, containing complete properties and dimension tables of various structural shapes, including diagram drawings of each. Also included are plate size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails and corrugated sheets.

## 149 SUB-SURFACE EXPLORATION

**The Giles Drilling Corporation**—A comprehensive booklet describes advanced sub-surface exploration technique in test borings for engineering. Emphasis is laid upon the fact that every engineering exploration presents its own individual sub-surface conditions and problems. This places a premium upon correct field technique and interpretation.

## 150 SURVEYING INSTRUMENTS

**C. L. Berger & Sons, Inc.**—A 16-page condensed catalog, "Accuracy in Action," illustrates the engineering and surveying instruments manufactured by the company. General characteristics, optical systems and accessories for the Berger line of engineers' transits, levels, mining transits, theodolites, collimators and alidades are fully described with essential specifications for each. A section devoted to builders' and contractors' instruments is also included.

## 151 SURVEYING INSTRUMENTS

**Kern Instruments, Inc.**—A 32-page brochure offers a brief description of the most important instruments manufactured by world-famed Kern & Co., Ltd., of Aarau, Switzerland. Fully illustrated, it acts as an index to the detailed literature available on each instrument. Included in the brochure are double-circle theodolites, self-reducing tachometers, plane table equipment, pentagonal prisms and many other exceptionally fine instruments.


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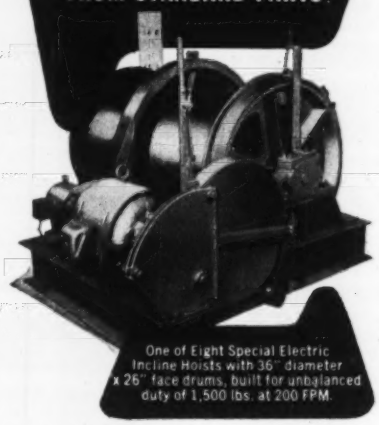

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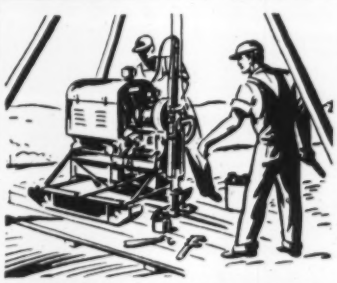

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# CATALOG DIGESTS

**152 SURVEYING INSTRUMENTS**

**Fennel Instrument Corporation of America**—offers a folder on their line of precision instruments. Photographs, detailed descriptions of the models, prices, etc., are included.

**153 SURVEYING INSTRUMENTS**

**The Union Mercantile Company**—Has literature available on the following surveying and engineering instruments: 18 in. dumpy level; 5 in. engineer's transit; 5¼ in. Engineer's Transit; and 11 in. builder's level. This literature describes the finest of Japanese optics built to standard American specifications. Prices are far below comparable values. These instruments are equal to the world's finest. Complete technical descriptions, photographs and price list are included.

**154 SURVEYING INSTRUMENTS**

**David White Company**—Offers Bulletin 1052 on surveying instruments for all purposes. The present edition tells the story of the most recent changes and developments in the field of surveying instruments and engineer's field supplies. The catalog presents an exceptionally large assortment of high-grade and up-to-the-minute products.

**155 SURVEYING INSTRUMENTS**

**David White Company**—Has published a series of bulletins known as "The White Way". Technical terms used by engineers and surveyors are clearly explained. Detailed information is given on; design and construction, how to set up a transit, uses and manipulation, etc. Many Universities are now using this series for class instruction.

**156 SWIMMING POOL EQUIPMENT**

**National Pool Equipment Co.**—Has for free distribution 20-page catalog fully illustrating the most complete line of highest quality pool supplies and equipment—full of drawings and charts for the prospective pool owner, architect or engineer.

**157 TANDEM ROLLER**

**The Galion Iron Works & Mfg. Co.**—A flyer describing features of the Galion 2 to 6 ton portable retractable Tandem Roller. Describes advantages of mobility, steering, transmission, compression and etc.

**158 TECHNICAL DATA CATALOG**

**Lefax**—Listing over 2000 subjects, the Lefax catalog of pocket size technical data books is off the press. These handy reference books cover every branch of engineering, are clear cut, comprehensive, authoritative, for use by engineers, technical workers, executives, etc. Continuously revised, each book contains approximately 140 pages of pertinent data including current advances. Subjects include: hydraulics, machine design, piping data, surveying tables, reinforced concrete, highway engineering, electricity AC-DC, AC motors and generators, and others.

**159 TENSIONING MATERIALS**

**John A. Roebling's Sons Corporation**—Catalog PC-929, "Tensioning Materials for Prestressed Concrete", offers detailed information and photographs of various construction jobs for which Roebling wire and strand have been used. Features are: uncoated prestressed concrete strand for pre-tensioned bonded design, strand fittings, post-tensioned design, tensioning applications and wire.

**160 THEODOLITE**

**Geo-Optic Company, Inc.**—Has a leaflet describing the optical universal theodolite Askania TKT Transit with terrestric telescope (erecting eyepiece). The Askania TKT Transit enables surveyors to cope with any possible problem of triangulation and to obtain results of the highest accuracy. All readings are done from one position—an important time factor. Other advantages and data are included.

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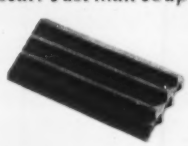

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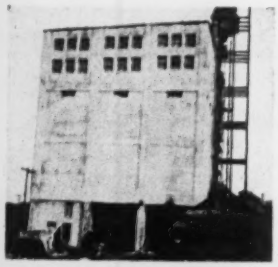

## CONCRETE BUILDING REPAIRED WITH "GUNITE"

This concrete structure is the breaker building at Cayuga Rock Salt Company, Myers, N. Y. The concrete was badly disintegrated due to infiltration of salt and resultant action on the reinforcing steel, as evidenced by the lower close-up photo.

The disintegrated concrete was chipped away and the entire area washed and sandblasted. Mesh reinforcement was placed and anchored into place with expansion bolts. Deeply chipped areas were first filled with "GUNITE" and then a 1-1/2" minimum layer of "GUNITE" applied over the entire area. The finished job is shown in the upper photo.

The concrete slab roof of the building was similarly repaired with "GUNITE" on both sides of the slab. Sufficient concrete was first chipped away so that the ultimate reintegrated slab would be the original thickness, thus preventing an increase in the dead load.

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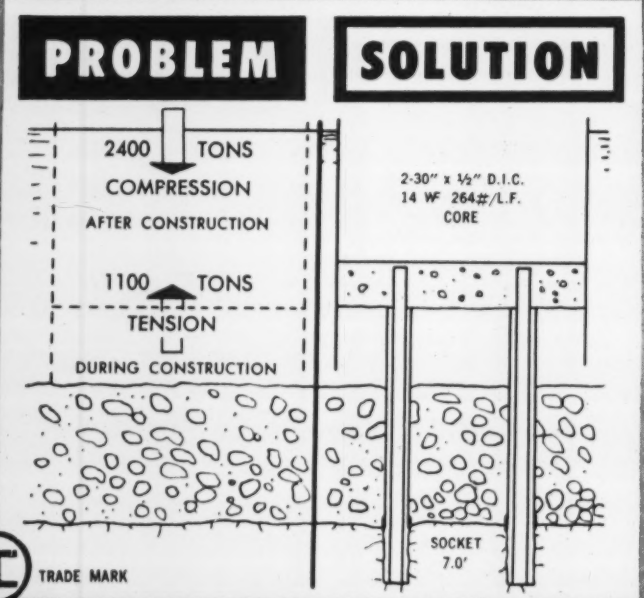


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# CATALOG DIGESTS

### 161 TIDE GATES

**Brown & Brown, Inc.**—Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

### 162 TILT-UP CONSTRUCTION

**Portland Cement Association**—A 32-page illustrated booklet discusses a method of construction in which wall panels are cast in the horizontal position, usually on the floor of the building and then tilted into a vertical position and tied together to form a wall. It covers the advantages, design, construction details, methods of tilting and insulation of walls.

### 163 TIMBER CONSTRUCTION

**Timber Structures, Inc.**—New color booklet, "Modern Construction with Engineered Timbers" shows the use of timber members as a modern engineering material. Technical data includes sizes and properties of glued laminated beams and purlins; standard thicknesses of laminations and limiting curvatures; arch dimensions; dimensions, sizes and weights of bowstring and parallel chord trusses.

### 164 TONGUE AND GROOVE JOINTS

**Servicised Products Corporation**—A tongue and groove joint one page circular describes tongue and groove joints produced by Servicised Products for forming keyed construction joints.

### 165 TRACTOR PARTS AND SERVICE

**Caterpillar Tractor Co.**—Has released an eight-page booklet, Form 30960, showing the intricate system of a successful parts program. The booklet tells the parts service story of a typical Caterpillar dealer from the time a customer places the order to the actual delivery. Bin storage and price practices, maintained stock, continuous inventory control and how emergency orders are expedited are all covered in detail.

### 166 TRANSITS

**Charles Bruning Company**—Brunson Engineer Transits, which incorporate patented dust-proof ball-bearing construction, are described in an eight page booklet now available. The booklet illustrates and describes various models of instruments, and explains how use of the ball-bearing principle permits operation in temperatures ranging from 70 degrees below zero to 160 degrees above zero, prevents costly maintenance through wear, and eliminates looseness in bearings.

### 167 TUNNEL & MINE EQUIPMENT

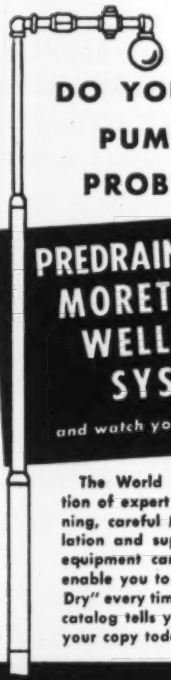
**Mayo Tunnel & Equipment**—Bulletin #15 shows photographs clearly illustrating various construction jobs using Mayo's equipment. Included are steel forms for tunnels, sewer and conduit forms and hydraulic equipment for shield.

### 168 TURBINES

**The James Leffel & Co.**—The Turbine Installation Folders #1085 describes in full detail the installations of Leffel Turbines at the Anderson Ranch Dam in Idaho. Materials pertaining to other Leffel projects will be included.

### 169 VERTICAL BOOM DITCHER

**Barber Greene Company**—The Model 705-B vertical boom ditcher is designed for use by contractors, governmental bodies and especially utilities companies. The ditcher has digging widths of 5-1/2 in., 7-1/2 in. and 10-1/2 in., and can dig to depth of 48 in. It is pneumatic-tired mounted and equipped with an automatic clean-out bucket, "hydracrowd," fluid coupling and the exclusive Barber-Greene vertical boom as well as many other design refinements. The digging buckets are equipped with the new patented curved tooth design. This 8-page, two-color booklet illustrates many typical applications and features of the 705-B "Runabout" service ditcher.



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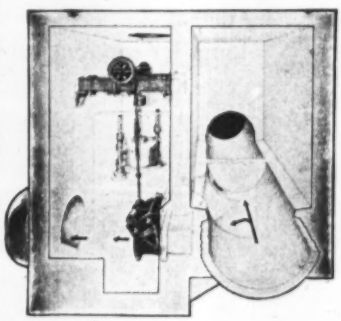

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

*Descriptive Bulletins and Engineering Data Available Upon Request*

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# CATALOG DIGESTS

**170 WATER & SEWAGE TREATING EQUIPMENT**

**Hardinge Company, Inc.**—Bulletin AH-442, illustrates various installations of Circular and Rectangular Clarifiers, Automatic Backwash Sand Filters, Hydro-Classifiers, Flocculating units and Digesters. Typical flow sheets are also included.

**171 WATER CONDITIONING**

**Graver Water Conditioning Co.**—Bulletin WC-108 explains the distinction between the sodium cycle and the hydrogen cycle of zeolite softening and graphically shows the differences in results obtained by the two processes; a description of the design and operation of equipment used in zeolite water softening; various types of modern zeolite or ion exchange materials, with photographs and photomicrographs of typical exchangers and an outline of a simple method of sizing zeolite softeners, with a table of recommended flow rates.

**172 WATER CONDITIONING DATA BOOK**

**The Permutit Company**—Pocket Size Data Book No. 2478A, 109 pages, compiled for the convenience of practicing engineers and those who work with water conditioning problems. It covers such subjects as hydraulics, impurities in water, chemicals used in water treatment, specific gravities, and chemical reactions. Included are 78 tables of information, bound in a gold imprinted leatherette cover.

**173 WATER CONTROL APPARATUS**

**Rodney Hunt Machine Co.**—a 250-page comprehensive catalog, WCA 952, shows the full scope of Rodney Hunt Water Control Apparatus. It consists of eight sections, sluice gates, timber gates, hoists, fabricated gates, racks and rakes, valves, engineering data. Included are hundreds of diagrams, photographs with detailed descriptions, and specifications. Offered only to consulting engineers, contractors and others actively engaged in water control construction work. Requests must be made on business or official letterheads, stating title and position.

**174 WATER DAMAGE CONTROL**

**Western Waterproofing Co.**—This is a practical, professional treatise on water damage control, written by an expert in the field, especially for church property administrators. In 6 pages of pictures and text the author discusses three basic types of treatment—preventive, remedial and restoration—and how and when they should be applied to the five common classes of construction usually found in church buildings—old brick, new brick, stone, concrete and pre-cast block.

**175 WATER FILTERS**

**Proportioneers, Inc.**—Bulletin 1800 describes Pur-O-Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swim pool recirculation systems. Engineering data on the application of these filters, including specifications and dimensions covering the complete recirculation and purification systems, are given.

**176 WATERPROOFING SERVICES**

**Western Waterproofing Co.**—A folder explains the "when, why and how" for specifying waterproofing services to protect new and old structures from above-grade water penetration, interior wall dampness and subsurface water seepage. Deals specifically with such problems as wet walls, shrinkage in brickwork and foundation water seepage and describes the scope and method of protection or restoration work that should be specified for each.

**177 WATERSTOPS-LABYRINTH TYPE**

**Water Seals, Inc.**—A bulletin describes the Harza labyrinth waterstop. The catalog includes description and drawings of typical applications for the new type waterstop, which features exceptional water tightness and ease of installation in the concrete forms.


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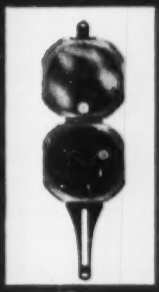

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## CATALOG DIGESTS

### 178 WATER WELLS, PUMPS, SERVICES

**Layne & Bowler, Inc.**—gives brief descriptions of its comprehensive water supply equipment and services for municipalities, industries and farms in new illustrated folders. Subjects include water well drilling, special drilling, vertical turbine pumps, irrigation pumps, specially designed pumps, shutter screens for gravel wall wells, water well acidizing and other service work. The folders describe additional helpful literature available on each of these subjects.

### 179 WATER WORKS PROMOTION

**Cast Iron Pipe Research Association**—Offers a 16-page, pocket-size booklet designed to stimulate community interest in a new or modernized water supply system. Consulting engineers will find this booklet helpful in promoting such projects. Describes advantages and benefits to the community, and how to plan financing, engineering, and campaigning for bond issue. Available without charge in reasonable quantities to citizen committees, civic and service organizations.

### 180 WELDED WIRE FABRIC

**American Steel & Wire Division**—Offers a six page illustrated folder, "American Welded Wire Fabric for Reinforcing Asphaltic Concrete Resurfacing," covering the development and present usage of wire fabric for reinforcing asphalt pavements. Folder gives advantages of using such reinforcing plus numerous actual application photographs. Also, gives their brief instructions.

### 181 WELLPOINT DEWATERING SYSTEM

**John W. Stang Corp.**—A catalog describes the component parts of the Stang wellpoint dewatering system; its planning, engineering and various methods of installation. Specific installations on dams, power houses, pipelines, tunnels, etc., are illustrated from photographs made in the field. Heavy construction of all types in all varieties of soil conditions where ground water is encountered is described fully.

### 182 WELLPOINT SYSTEM

**Griffin Wellpoint Corp.**—The Wellpoint System in Principle and Practice in the use of wellpoint systems are described in a handbook now available. This handbook contains information on how a wellpoint system functions and describes methods of planning, layout, installation, operation, and removal of the system. The manual is pocket-size, 109 pp in length, and contains 62 diagrams and illustrations. Price is $1.50.

N. B. *There is a charge for this book. Make checks payable to Griffin Wellpoint Corp.*

### 183 WELLPOINT SYSTEM

**Moretrench Corporation**—A new, informative, 76-page catalogue, fully illustrated, describes the Moretrench Wellpoint System and its use in dewatering various types of construction projects. Includes useful technical data on System.

### 184 WIRE ROPE

**American Steel & Wire Division**—Offers "Longer Life from your Wire Rope", a booklet of valuable facts about the use and care of wire rope. The information presented in this booklet is intended for use as a guide offering practical facts and suggestions that you will find useful in helping you to get maximum service from your wire rope.

### 185 WIRE ROPE AND SLINGS

**L. B. Foster Company**—Tables which give technical data on the approximate strength and weight of various types of wire, rope, in all sizes from 1/4 in. in diameter to 2 1/2 in. in diameter, are featured in a new bulletin titled, "Wire Rope and Slings". The 4 page bulletin also has illustrations of slings, blocks, clips, hooks, sockets, shackles, turnbuckles, etc.

### 186 WOOD STRUCTURES

**Timber Engineering Company**—Is offering their annual report on spectacular wood structures that set new precedents in engineered timber construction during 1953. Photographs with descriptions are included in the report.

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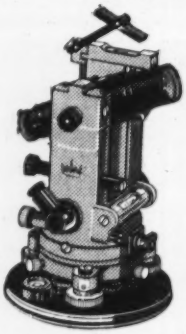

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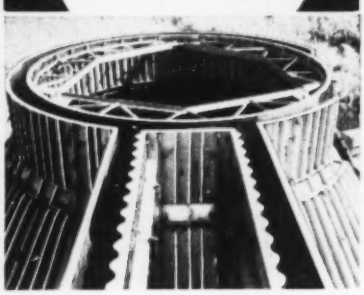

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# PROCEEDINGS AVAILABLE

The following papers have become available as Proceedings-Separates. Following the date of issue of a paper, discussions thereof will be received for a period of three months, as specified on the cover of the paper. Titles will be added to this list every month, as they become available. Technical division sponsorship is indicated by an abbreviation at the end of each item, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. Papers issued prior to, and including, Separate No. 289, were not distributed under the present automatic mailing system. If you have not registered in a Technical Division to receive its papers (one Division only) free of charge, please do so promptly by filling out and mailing the enrollment and subscription form (page 129) to Society Headquarters. For ordering separate papers, use the convenient order form on page 128.

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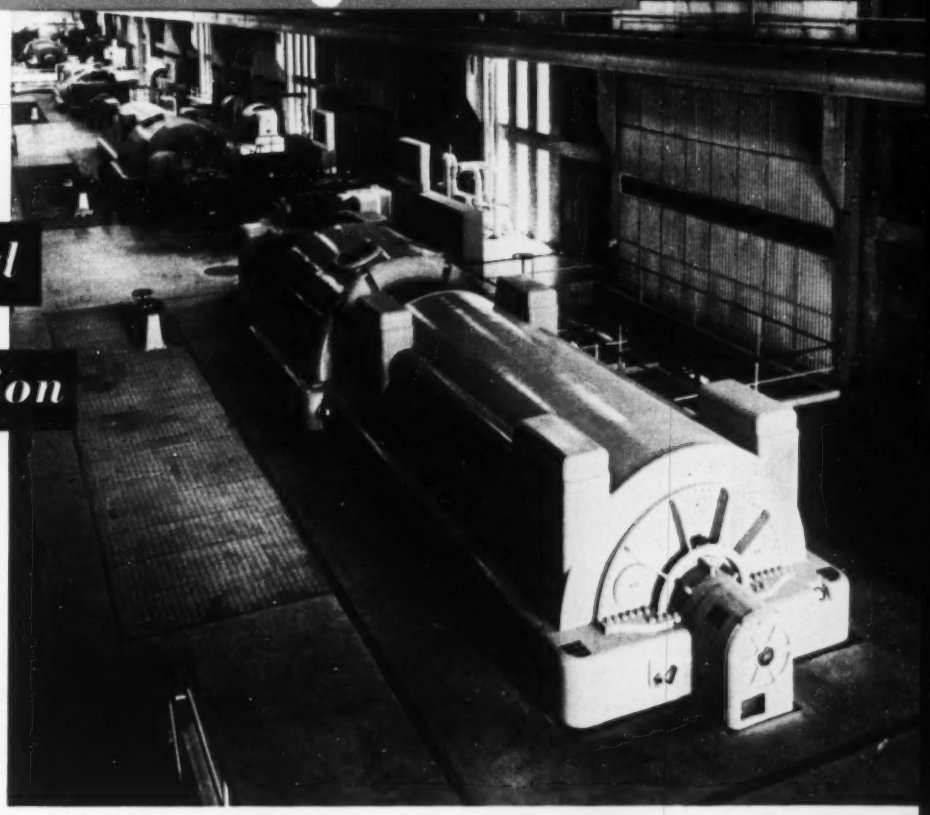

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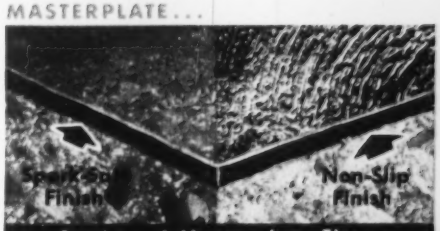


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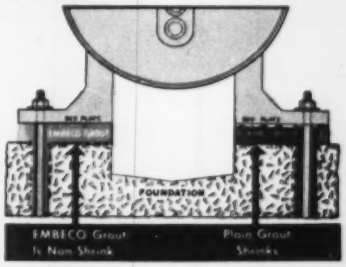


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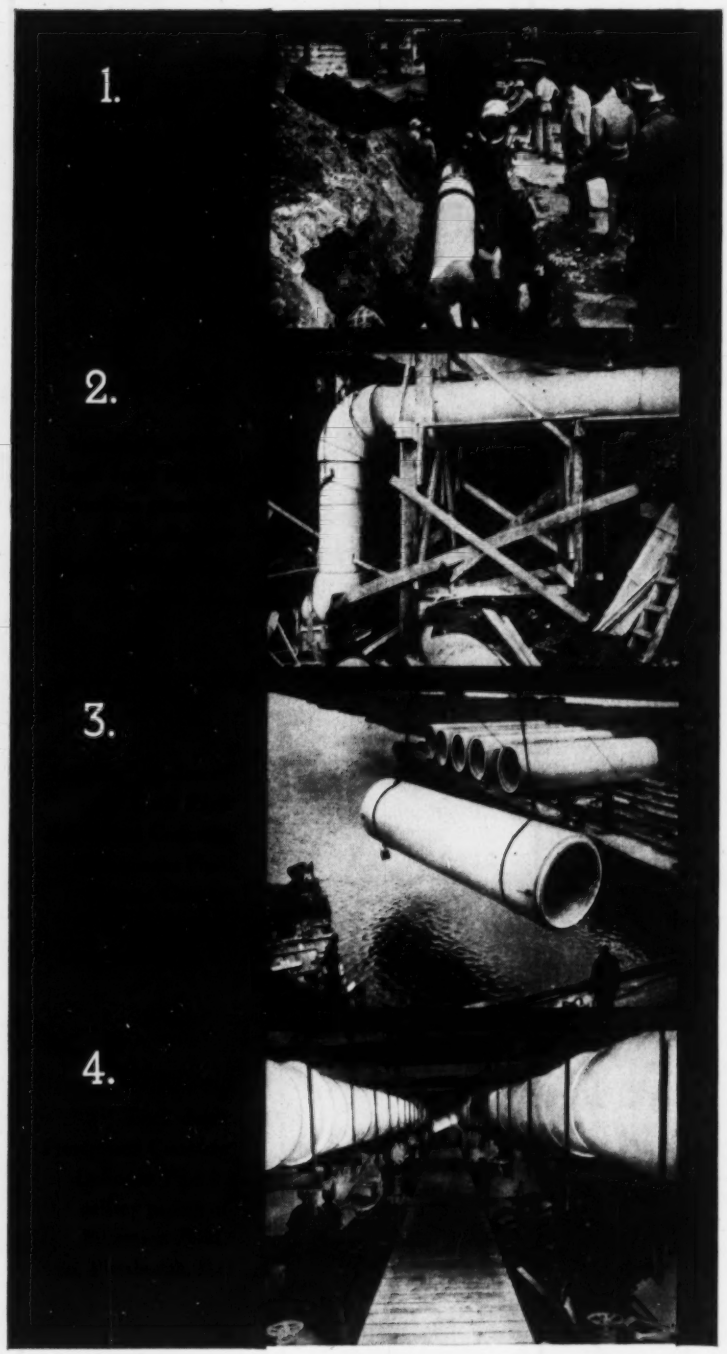


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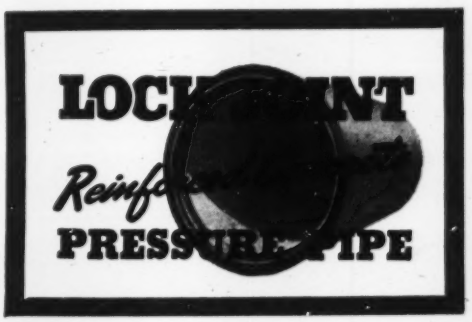
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